

## FEMALE LEPIDOPTERA AT LIGHT TRAPS

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### INTRODUCTION

It appears to be the generally accepted theory that in the Lepidoptera practically all individuals taken at a light trap are males, and that of the few females so captured all have oviposited previously. During the summer of 1916 extended observations were made at the Hagerstown, Maryland, field station of the Bureau of Entomology in an effort to secure some definite information as to the relative proportions of the sexes of moths attracted to the light and the percentage of gravid females among those so taken. The purpose of this paper is to give a brief account of the methods employed to obtain material and a summary of the facts brought out by a detailed examination of such material.

The attracting light used was an arc lamp of 300 candlepower hung in an inverted truncated cone of heavy tin. One-half of the cone which would otherwise encircle the lamp was cut away; the narrow (lower) end of the cone was fitted in the circular opening in the top of the trap. Immediately below this opening are arranged several plates of glass at angles to direct the moths downward into the body of the trap. The trap is 12 by 14 inches and 20 inches high. Two sides are of wire mesh, the other sides and the top and bottom being of wood. To kill the captured insects, the trap was placed in a tightly constructed box with a small vessel of carbon disulphid placed at the top of the trap.

The individuals of some twenty-odd species were preserved in alcohol, with the date of each collection. Later these were determined as to sex and the number of males and females tabulated for each date. The females were carefully dissected and tabulated as to the stage of ova development.

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No attempt was made to determine specifically the individuals of the genus *Feltia*, of which it is probable that the following four species were taken: *Feltia subgothica* Haworth, *F. annexa* Treitschke, *F. gladiatoria* Morrison, and *F. jaculifera* Guenée.

The material collected and examined embraces a little over 11,000 individuals, representing 3 families and about 20 species. Table I gives the results of an examination of this large number of moths to determine the sex. No extended résumé is attempted in the text beyond a brief statement of some of the more salient facts.

Of the 11,222 moths examined, 8,025, or 71.5 per cent, were males; 3,197, or 28.5 per cent, were females. In only one species, *Noctua c-nigrum*, did the females taken equal or exceed the males.

TABLE I.—Number and percentage of males and females of various species of *Lepidoptera* taken at a light trap, Hagerstown, Md., 1916

Species.	Number of males.	Number of females.	Total.	Percentage of males.	Percentage of females.
<i>Apantesis vittata</i> Fabricius . . . . .	1, 158	25	1, 183	97.9	2.1
<i>Apantesis arge</i> Drury . . . . .	14	3	17	82.3	17.7
<i>Estigmene acraea</i> Drury . . . . .	404	60	473	85.4	14.6
<i>Diacrisia virginica</i> Fabricius . . . . .	66	8	74	88.0	12.0
<i>Isia isabella</i> Smith and Abbot . . . . .	256	42	298	86.0	14.0
<i>Halisidota tessellaris</i> Smith and Abbot . . . . .	282	123	405	69.6	30.4
<i>Datana ministra</i> Drury . . . . .	47	19	66	71.2	28.8
<i>Arsilonche albovenosa</i> Goeze . . . . .	111	11	122	90.0	10.0
<i>Autographa biloba</i> Stephens . . . . .	38	2	40	95.0	5.0
<i>Autographa simplex</i> Guenée . . . . .	223	71	294	75.8	24.2
<i>Meliana diffusa</i> Walker . . . . .	159	19	178	89.4	10.6
<i>Polia renigera</i> Stephens . . . . .	192	77	269	71.4	28.6
<i>Caenurgia erectea</i> Cramer . . . . .	1, 437	833	2, 270	64.1	35.9
<i>Caenurgia crassiuscula</i> Haworth . . . . .	973	566	1, 539	64.5	35.5
<i>Cirphis unipuncta</i> Haworth . . . . .	552	424	976	56.5	43.5
<i>Noctua c-nigrum</i> Linnaeus . . . . .	95	107	202	47.0	53.0
<i>Feltia</i> spp . . . . .	2, 018	798	2, 816	71.7	28.3
Total . . . . .	8, 025	3, 197	11, 222	71.5	28.5

Table II gives the percentage of gravid females and shows that of 3,197 individuals dissected, 1,857, or 58 per cent, were gravid. These gravid females make up 16.6 per cent of the 11,222 moths examined.

It will be noted that all the females of four of the six species of *Arcytiidae* under observation were gravid, and in the two other species the gravid females represent 85.5 per cent and 96 per cent of females collected. These facts, together with data as to the number and development of the eggs, are to be found in Table III.

TABLE II.—Number and percentage of gravid female Lepidoptera taken at a light trap, Hagerstown, Md., 1916

Species.	Number of females taken.	Spent.	Gravid.	
			Number.	Per cent.
<i>Apantesis vittata</i> Fabricius.....	25	0	25	100.0
<i>Apantesis arge</i> Drury.....	3	0	3	100.0
<i>Estigmene acraea</i> Drury.....	69	10	69	85.5
<i>Dacrisia virginica</i> Fabricius.....	8	0	8	100.0
<i>Isia isabella</i> Smith and Abbot.....	42	0	42	100.0
<i>Halisdota tessellaris</i> Smith and Abbot.....	123	5	118	96.0
<i>Autographa biloba</i> Stephens.....	2	2	0	0.0
<i>Autographa simplex</i> Guenée.....	71	19	52	73.0
<i>Meliana diffusa</i> Walker.....	19	12	7	37.0
<i>Polia renigera</i> Stephens.....	77	10	67	87.0
<i>Caenurgia erectea</i> Cramer.....	833	389	444	53.3
<i>Caenurgia crassiuscula</i> Haworth.....	566	290	276	48.7
<i>Cirphis unipuncta</i> Haworth.....	424	85	339	80.0
<i>Noctua c-nigrum</i> Linnaeus.....	107	58	49	44.8
<i>Arsilonche albovenosa</i> Goeze.....	11	0	11	100.0
<i>Feltia</i> spp.....	798	394	404	50.6
<i>Datana ministra</i> Drury.....	19	0	19	100.0
Total.....	3,197	1,340	1,857	58.0

TABLE III.—Condition of the ovaries of Lepidoptera taken at a light trap, Hagerstown, Md., 1916

## APANTESIS VITTATA

Date.	Number taken.	Condition of ovaries.		Number and development of eggs.
		Spent.	Gravid.	
July 26	2	0	2	11D; 93D.
30	3	0	3	116D; 96D; 123D.
31	2	0	2	67D; 76D.
Aug. 3	6	0	6	120D; 146D; 122D; 131D; 96D; 224D.
4	5	0	5	78D; 89D; 108D; 95D; 113D.
6	3	0	3	77D; 53D; 47D.
8	1	0	1	103D.
9	1	0	1	139D.
15	1	0	1	166D.
22	1	0	1	113D.

## APANTESIS ARGE

July 20	1	0	1	156D.
26	1	0	1	97D.
Aug. 25	1	0	1	129D.

TABLE III.—Condition of the ovaries of *Lepidoptera* taken at a light trap, Hagerstown, Md., 1916—Continued

ESTIGMENE ACRAEA					
Date.	Number taken.	Condition of ovaries.			Number and development of eggs.
		Spent.	Gravid.		
June 23	1	1	0		
29	1	0	1	187D.	
July 1	1	0	1	98D.	
2	1	0	1	117D.	
14	1	1	0		
27	1	0	1	203D.	
30	1	0	1	128D.	
31	7	0	7	All fully developed but not counted.	
Aug. 1	1	0	1	153D.	
3	5	0	5	All fully developed but not counted.	
4	1	1	0	Do.	
5	5	0	5	Do.	
6	1	1	0	Do.	
8	3	1	2	147D; 138D.	
9	1	1	0	Do.	
10	2	1	1	186D.	
11	1	0	1	227D.	
13	1	0	1	236D.	
17	2	0	2	All fully developed but not counted.	
18	3	1	2	Do.	
19	3	1	2	Do.	
20	3	1	2	Do.	
21	4	0	4	Do.	
22	3	0	3	Do.	
23	5	0	5	Do.	
24	5	0	5	Do.	
25	4	0	4	Do.	
28	2	0	2	Do.	
DIACRISIA VIRGINICA					
June 28	2	0	2	238D; 609D.	
July 2	1	0	1	514D.	
24	1	0	1	488D.	
28	1	0	1	378D.	
29	1	0	1	471D.	
31	1	0	1	538D.	
Aug. 6	1	0	1	493D.	
ISIA ISABELLA					
July 30	3	0	3	217D; 165D; 126D; 155D.	
31	5	0	5	287D; 175D; 214D; 391D; 393D.	
Aug. 1	2	0	2	257D; 218D.	
2	1	0	1	212D.	
3	1	0	1	223D.	
4	7	0	7	Averaged 252D.	
5	7	0	7	Averaged 217D.	
6	1	0	1	158D.	
8	2	0	2	164D; 192D.	
9	3	0	3	387D; 320D; 392D.	

TABLE III.—Condition of the ovaries of Lepidoptera taken at a light trap, Hagerstown, Md., 1916—Continued

## ISIA ISABELLA—continued

Date.	Number taken.	Condition of ovaries.		Number and development of eggs. <sup>a</sup>
		Spent.	Gravid.	
Aug. 10	1	0	1	129D.
19	1	0	1	229D.
21	1	0	1	274D.
22	3	0	3	287D; 278D; 239D.
23	1	0	1	285D.
24	1	0	1	377D.
25	1	0	1	248D.
Sept. 1	1	0	1	116D.

## HALISIDOTA TESSELLARIS

July 1	4	1	3	137D; 218D; 186D.
2	3	0	3	298D; 150D(e); 200D(e).
3	13	0	13	293D; 68D; 98D; 128D; 9 averaged 167D.
4	9	0	9	5 averaged 257D; 4 averaged 137D.
6	4	0	4	168D; 157D; 128D; 92D.
7	6	0	6	128D; 153D; 4 averaged 206D.
8	21	0	21	6 averaged 260D; 15 averaged 180D.
10	4	0	4	178D; 58D; 100D(e); 75D(e).
14	2	0	2	280D; 124D.
18	6	0	6	278D; 238D; 217D; 3 averaged 250D(e).
19	4	0	4	283D; 3 averaged 225D(e).
20	10	1	9	213D; 119D; 183D; 198D; 5 averaged 180D(e).
23	10	2	8	128D; 58D; 67D; 5 averaged 110D(e).
24	1	0	1	139D.
26	3	0	3	296D; 200D(e); 225D(e).
28	10	0	10	134D; 129D; 96D; 125D; 164D; 5 averaged 105D.
29	2	1	1	108D.
31	1	0	1	143D.
Aug. 1	3	0	3	195D; 97D; 128D.
4	1	0	1	238D.
6	1	0	1	173D.
7	1	0	1	143D.
18	4	0	4	106D; 88D; 118D; 138D.

## DATANA MINISTRA

July 23	7	0	7	Averaged 248D.
24	4	0	4	81D; 172D; 93D; 125D.
26	1	0	1	81D.
29	1	0	1	76D.
30	3	0	3	91D; 141D; 224D.
Aug. 1	1	0	1	6D.
3	1	0	1	263D.
4	1	0	1	332D.

<sup>a</sup> (e) = Estimated.

TABLE III.—Condition of the ovaries of *Lepidoptera* taken at a light trap, Hagerstown, Md., 1916—Continued

ARSILONCHE ALBOVENOSA					
Date.	Number taken.	Condition of ovaries.			Number and development of eggs.
		Spent.	Gravid.		
July	4	3	0	3	157S; 173S; 186S.
	10	2	0	2	377D; 272D.
	13	1	0	1	182S.
Aug.	17	1	0	1	357—198D and 159S.
	19	2	0	2	315—153D and 162S; 52D; 162S.
	23	2	0	2	213D; 263D.
AUTOGRAPHA BILOBA					
July	4	1	1	0	
Aug.	15	1	1	0	
AUTOGRAPHA SIMPLEX					
June	23	15	5	10	Immature; not counted.
	28	3	0	3	78D; 113D; 67D.
	29	1	0	1	151D.
July	1	9	3	6	Averaged 123D.
	2	7	2	5	Averaged 146D.
	4	1	1	0	
	6	6	0	6	Averaged 92D.
	7	6	0	6	Averaged 79D.
	8	12	4	8	Averaged 88D.
	27	1	1	0	
	30	1	0	1	128D.
Aug.	1	1	0	1	145D.
	3	1	1	0	
	4	2	2	0	
	8	3	0	3	78D; 75D; 75D.
Oct.	4	2	0	2	156D; 168D.
MELIANA DIFFUSA					
June	23	1	1	0	
	29	3	2	1	75D.
July	19	1	0	1	78D.
Aug.	9	1	0	1	54D.
	10	2	0	2	59D; 64D.
	16	1	0	1	79D.
	20	1	1	0	
	21	2	2	0	
	24	2	2	0	
	25	1	0	1	79D.
	28	1	1	0	
	31	1	1	0	
Sept.	2	2	2	0	

TABLE III.—Condition of the ovaries of Lepidoptera taken at a light trap, Hagerstown, Md., 1916—Continued

POLIA RENIGERA

Date.	Number taken.	Condition of ovaries.		Number and development of eggs. <sup>a</sup>
		Spent.	Gravid.	
June	23	11	1	10 Averaged 60D.
	28	6	2	4 63D; 42D; 53D; 68D.
July	29	22	3	10 Averaged 52D.
	1	8	0	8 Averaged 73D.
	3	12	2	10 Averaged 39D.
	6	3	1	2 23D; 75D.
	8	4	0	4 51D; 28D; 43D; 73D.
	10	2	0	2 32D; 43D.
Aug.	24	1	0	1 38D.
	22	1	0	1 43D.
	23	7	1	6 Averaged 57D.

CAENURGIA ERECTEA

June	28	8	2	6 4 averaged 42D; 125S(e); 150S(e).
	29	11	4	7 Averaged 51D.
July	1	39	13	26 16 averaged 53D; 10 averaged 125S(e).
	2	18	7	11 6 averaged 29D; 5 averaged 125S(e).
	3	63	21	42 30 averaged 62D; 12 averaged 130S.
	4	20	8	12 9 averaged 44D; 3 averaged 110S.
	6	38	10	28 25 averaged 47D; 3 averaged 150S(e).
	7	44	12	32 30 averaged 45D; 2, 125S each (e).
	8	97	49	48 40 averaged 57D; 8 averaged 150S(e).
	10	7	2	5 Averaged 43D.
	14	2	0	2 26D; 21D.
	18	5	3	2 23D; 26D.
	19	11	6	5 Averaged 28D.
	20	12	4	8 Averaged 31D.
	23	17	7	10 Averaged 51D.
	24	6	3	3 27D; 54D; 100D.
	26	6	2	4 Averaged 104D.
	28	1	0	1 86D.
Aug.	29	1	1	0
	30	4	4	0
	1	1	0	1 21D.
	2	1	1	0
	3	10	5	5 Averaged 59D.
	4	3	2	1 19D.
	7	1	0	1 34D.
	8	12	5	7 Averaged 55D.
	9	6	5	1 33D.
	10	44	23	21 18 averaged 32D; 3 averaged 130S(e).
	12	2	1	1 6D.
	13	1	1	0
	14	3	3	0
	15	13	7	6 75D; 5 averaged 22D.
	16	5	2	3 16D; 31D; 23D.
	17	18	7	11 8 averaged 53D; 3 averaged 130S(e).
	18	12	7	5 4 averaged 43D; 175S(e).
	19	10	6	4 Averaged 25D.
20	9	5	4 Averaged 44D.	
21	23	11	12 9 averaged 46D; 3 averaged 150S(e).	
22	31	20	11 10 averaged 42D; 1, 125S(e).	
23	62	36	26 19 averaged 40D; 7 averaged 125S(e).	
24	38	24	14 10 averaged 43D; 4 averaged 110S(e).	

<sup>a</sup> (e) = Estimated.

TABLE III.—Condition of the ovaries of *Lepidoptera* taken at a light trap, Hagerstown, Md., 1916—Continued

## CAENURGIA ERECHTEA—continued

Date.	Number taken.	Condition of ovaries.		Number and development of eggs. <sup>a</sup>
		Spent.	Gravid.	
Aug. 25	40	22	18	15 averaged 36D; 3 averaged 75S(e).
28	3	1	2	24D; 32D.
30	24	13	11	9 averaged 34D, 75S(e); 100S(e).
31	24	14	10	Averaged 30D.
Sept. 1	13	3	10	Averaged 31D.
2	5	4	1	23D.
14	6	1	5	Averaged 51D.
18	1	1	0	
Oct. 6	2	1	1	22D.

## CAENURGIA CRASSIUSCULA

June 28	4	1	3	96D; 108D; 57D.
29	4	2	2	53D; 28D.
July 1	19	7	12	8 averaged 53D; 4 averaged 125S(e).
2	9	3	6	3 averaged 29D; 3 averaged 125S(e).
3	29	10	19	11 averaged 62D; 8 averaged 130S(e).
4	10	4	6	3 averaged 44D; 3 averaged 110S.
6	21	6	15	13 averaged 47D; 2, 150S(e).
7	22	6	16	13 averaged 45D; 3 averaged 125S(e).
8	51	29	22	17 averaged 51D; 5 averaged 150S(e).
10	4	1	3	29D; 43D; 21D.
14	2	1	1	47D.
18	4	0	4	Averaged 25D.
19	6	3	3	Averaged 67D.
20	9	7	2	19D; 16D.
23	3	1	2	81D; 56D.
24	1	1	0	
26	3	2	1	128S.
Aug. 1	1	1	0	
2	2	2	0	
3	5	3	2	100D; 25D.
6	2	2	0	
8	6	3	3	21D; 100S(e); 100S(e).
9	5	4	1	75D.
10	13	8	5	3 averaged 32D; 100S(e); 100S(e).
12	3	3	0	
13	2	0	2	41D; 31D.
14	5	5	0	
15	24	13	11	8 averaged 22D; 3 averaged 75S.
16	8	4	4	Averaged 31D.
17	20	9	11	7 averaged 53D; 4 averaged 130S(e).
18	23	12	11	8 averaged 43D; 3 averaged 100S(e).
19	19	11	8	Averaged 38D.
20	17	9	8	Averaged 44D.
21	25	13	12	10 averaged 40D; 125S(e); 175S(e).
22	68	40	28	22 averaged 42D; 6 averaged 125S(e).
23	63	37	26	20 averaged 40D; 6 averaged 125S(e).
24	13	6	7	6 averaged 43D; 125S(e).
25	15	9	6	5 averaged 36D; 100S(e).
28	2	1	1	64D.
30	12	6	6	5 averaged 34D; 75S.
31	8	4	4	Averaged 30D.
Sept. 2	3	1	2	42D; 28D.
14	1	0	1	75D.

<sup>a</sup> (e)=Estimated.



TABLE III.—Condition of the ovaries of Lepidoptera taken at a light trap, Hagerstown, Md., 1916.—Continued

CIRPHIS UNIPUNCTA				
Date.	Number taken.	Condition of ovaries.		Number and development of eggs. <sup>a</sup>
		Spent.	Gravid.	
June 28	4	0	4	578D; 539D; 550D; 575D.
29	3	0	3	638D; 619D; 543D.
July 1	19	6	13	118D; 483D; 648D; 10 averaged 475D(e).
2	7	1	6	397D; 378D; 586D; 3 averaged 400D(e).
3	42	10	32	4 averaged 362D; 28 averaged 375D(e).
4	13	3	10	523D; 618D; 703D; 600D(e); 550D(e); 525D(e); 575D(e); 500D(e); 525D(e); 325D(e).
6	13	1	12	638D; 679D; 587D; 9 averaged 535D(e).
7	90	11	79	128D; 383D; 744D; 773D; 75 averaged 525D(e).
8	57	21	36	625D; 587D; 634D; 718D; 32 averaged 365D(e).
10	22	5	17	625D; 473D; 587D; 713D; 13 averaged 505D(e).
18	10	2	8	713D; 628D; 478D; 5 averaged 475D(e).
19	14	3	11	554D; 623D; 478D; 8 averaged 512D(e).
20	12	0	12	657D; 713D; 538D; 9 averaged 530D(e).
23	19	8	11	107D; 78D; 576D; 8 averaged 565D(e).
24	2	2	0	
27	6	2	4	663D; 587D; 713D; 629D.
28	8	1	7	684D; 593D; 567D; 4 averaged 550D(e).
29	3	0	3	567D; 627D; 493D.
30	5	0	5	692D; 563D; 478D; 450D(e); 525D(e).
31	4	1	3	613D; 576D; 550D(e).
Aug. 1	4	0	4	273D; 438D; 557D; 425D.
2	2	0	2	397D; 453D.
3	15	2	13	625D; 583D; 518D; 10 averaged 477D(e).
4	11	0	11	576D; 487D; 682D; 8 averaged 528D(e).
6	5	0	5	718D; 700D; 475D; 525D; 375D.
7	1	0	1	378D.
8	6	0	6	486D; 726D; 4 averaged 550D(e).
9	7	0	7	623D; 6 averaged 495D(e).
10	10	3	7	387D; 658D; 5 averaged 480D(e).
11	5	1	4	487D; 633D; 550D(e); 425D(e).
16	1	1	0	
19	1	0	1	563D.
22	2	0	2	432D; 328D.
Sept. 27	1	1	0	

  

NOCTUA C-NIGRUM				
Aug. 8	5	3	2	Fully developed; not counted.
9	13	10	3	Do.
10	7	5	2	Do.
11	2	2	0	
14	1	0	1	Do.
15	1	0	1	Do.
18	7	2	5	Do.
21	2	1	1	Do.
22	11	7	4	Do.
23	15	8	7	Do.
24	13	6	7	Do.
25	7	3	4	Do.
30	7	3	4	218D; 198D; 238D; 1 not counted.
31	5	2	3	Fully developed; not counted.
Sept. 1	1	1	0	

<sup>a</sup> (e) = Estimated.

TABLE III.—Condition of the ovaries of *Lepidoptera* taken at a light trap, Hagerstown, Md., 1916—Continued

## NOCTUA C-NIGRUM—continued

Date.	Number taken.	Condition of ovaries.		Number and development of eggs. <sup>a</sup>
		Spent.	Gravid.	
Sept. 2	2	0	2	Fully developed; not counted.
14	2	2	0	
18	3	1	2	Do.
Oct. 6	3	2	1	Do.

## FELTIA SPP.

Aug. 8	4	0	4	200D(e); 200D(e); 300S(e); 300S(e).
9	3	1	2	69D; 198D.
10	3	1	2	154D; 300S(e).
12	1	0	1	43D.
14	1	0	1	233D.
15	3	1	2	73D; 250S(e).
17	1	0	1	432S.
18	1	0	1	254D.
19	1	0	1	238D.
20	3	0	3	101D; 154D; 298D.
21	14	1	13	78D; 158D; 149D; 98D; 228S; 4 averaged 288S; 4 averaged 213D.
22	43	10	33	7 averaged 163D; 22 averaged 112D; 4 averaged 250S(e).
23	38	5	33	7 averaged 117D; 20 averaged 130D(e); 6 averaged 258S(e).
24	38	10	28	112D; 183D; 74D; 81D; 218D; 228S; 258S; 16 averaged 113D(e); 5 averaged 230S(e).
25	65	20	45	10 averaged 120D; 5 averaged 277S; 21 averaged 125D(e); 9 averaged 293S(e).
28	8	2	6	258D; 128D; 178D; 151D; 200S(e); 200S(e).
30	75	16	59	128D; 78D; 64D; 159D; 235S; 346S; 271S; 43 averaged 115D(e); 9 averaged 225S(e).
31	57	32	25	128D; 174D; 64D; 152D; 137D; 154D; 176D; 8 averaged 120D(e); 10 averaged 219S(e).
Sept. 1	33	6	27	221D; 153D; 186D; 131D; 74D; 68D; 18 averaged 154D(e); 200S(e); 200S(e); 468S.
2	26	6	20	78D; 153D; 47D; 53D; 5 averaged 100D; 11 averaged 136D(e).
4	11	10	1	141D.
5	10	9	1	128D.
7	11	7	4	18D; 209D; 74D; 199D.
14	127	91	36	236D; 158D; 95D; 101D; 128D; 86D; 30 averaged 94D(e).
18	54	47	7	196D; 156D; 116D; 76D; 226S; 125D(e); 50D(e).
27	37	29	8	86D; 180D; 76D; 226D; 4 averaged 88S(e).
28	85	48	37	96D; 126D; 233D; 76D; 56D; 74D; 101D; 30 averaged 120D(e).
Oct. 6	45	42	3	219D; 48D; 54D.

<sup>a</sup> (e)—Estimated.

The one species (*Datana ministra*) of the Notodontidae is represented by 19 females, all of which were gravid.

Among the Noctuidae all the females of one species (*Arsilonche albovenosa*) were found to be gravid. One species, *Autographa biloba*, is

represented by only 2 females, both spent. Of the remaining species of this family the percentage of gravid females varies from 37 per cent in *Meliana diffusa* to 87 per cent in *Polia renigera*. Of the 424 females of *Cirphis unipuncta* dissected, 80 per cent were gravid, the eggs ranging in number from 107 to 773, all fully developed.

Some explanation is required as to the method of arriving at the number of eggs accredited to a female moth where a footnote to a table reads "Estimated." The ovarian structure was dissected and spread for counting the eggs, adopting a unit of 25 eggs. The remaining ovarian material was divided into masses of the bulk of that containing 25 eggs. This method was frequently verified by actual counts and it is believed that the figures are dependable. Where no such reference appears, the actual count was made. In every case the stage of development was determined under the hand lens or binocular and indicated in Table III by "D" for "developed" and by "S" for "immature."

Any data as to the relative proportions of male and female Lepidoptera taken at a light trap have an added value when considered in connection with information bearing on these relations of the sexes in nature. For this reason the writer has endeavored to get together all facts to be had from available sources, and brief notes on the subject are cited here under the name of the species concerned.

EUPROCTIS CHRYSORRHOEA LINNAEUS (3, p. 47-48)<sup>1</sup>

Concerning the brown-tail moth Fernald and Kirkland write as follows:

In July, 1897, a quantity of cocoons and pupæ was gathered and placed in a large glass-covered box, the moths being removed as they emerged. The following . . . shows the relative proportion of the sexes: Males, 399; females, 451.

ELASMOPALPUS LIGNOSELLUS ZELLER (10, p. 20)

Records obtained at Columbia, S. C., in 1915. From 56 pupæ there emerged 23 males and 33 females.

PHTHORIMARA OPERCULELLA ZELLER (4, p. 24)

Graf records the following data with regard to the proportion of sexes of the potato-tuber moth:

The proportion of the sexes during the year remains very nearly constant and almost equal. Pupæ selected at random at various times of the year gave the results shown in Table 3. (327 males, 284 females.)

CRAMBUS HORTUPELLUS HUEBNER (15, p. 8)

With regard to the cranberry girdler, Scammell records the following data:

In the early summer the males and females appear to be about equal in number; for example, on June 11, 24 moths were collected, of which 12 were males and 12 females. In late summer, however, the males are far in excess of the females, as shown by the following collections: Thirteen moths taken July 27 consisted of 11 males and 2 females, while of 23 moths collected August 10 only 5 were females.

<sup>1</sup> Reference is made by number (italic) to "Literature cited," p. 148-149.

## PLUTELLA MACULIPENNIS CURTIS (11, p. 5)

Information as to the proportional relations of the two sexes in this species is not particularly definite in the paper by Mr. Marsh, his statement being: "Fifty-two adults, about equally divided as to sex, developed on November 2 and 3." In the summing up of such data as the writer has been able to assemble, this species appears in Table XX as 26 males and 26 females.

## CARPOCAPSA POMONELLA LINNAEUS (16)

A general deduction from all data given of rearings puts the proportional relations of the sexes as nearly equal, with a very slight preponderance of females. The same species (5, p. 52) is reported by Mr. A. G. Hammar as including 456 males and 563 females in a total of 1,019 individuals. Further information as to the codling moth is to be found in the paper by Messrs. Jones and Davidson (9, p. 120-121), where, in Table VI, the moths issuing from 151 pupæ are shown to comprise 67 males and 84 females. In Table XXIX (9, p. 146), of 65 adults 32 are reported as males, 33 as females, while in Table XL (9, p. 153) the males make up only 21 of a total of 54. Summing up the data for *C. pomonella* it is found that of 1,289 individuals the males include 576; the females 713; a percentage of 44.7 and 55.3, respectively.

## SANNINOIDEA OPALESCENS HENRY EDWARDS (12, p. 79)

Mr. Dudley Moulton in his records for 1908 and 1909 on this species accounts for 232 adults and lists them as 118 males, 114 females.

## SYNANTHEDON PICTIPES GROTE AND ROBINSON (8, p. 411)

Mr. J. L. King, in his paper on the lesser peach-tree borer, places 12 adults as to sex; 4 are determined as males and 8 as females. On the same page of the bulletin five adults are divided as to sex into 2 males and 3 females.

## ARCHIPS ARGYROSPILA WALKER (6, p. 257)

Messrs. Herrick and Leiby had under observation 227 pupæ from larvæ kept in jars "in an open air insectary under normal conditions of temperature." Sex determinations of 155 individuals proved 85 to be males and 70 to be females.

The same species was under observation by Mr. W. M. Davidson (2) in 1911, who states that of 76 adults 29 were males and 47 were females.

## ARCHIPS ROSACEANA HARRIS (14, p. 306)

In an article by E. D. Sanderson and Mrs. A. D. Jackson, published in the Journal of Economic Entomology, December, 1909, the authors state that from 62 pupæ there issued 35 males and 27 females.

## HALISIDOTA CARYAE HARRIS (7, p. 8)

Mr. Dwight Isely had this species under observation at North East, Pa., during the summers of 1915 and 1916. He records that of 25 adults reared 17 were males and 8 were females.

## CHLORIDEA OBSOLETA FABRICIUS (13, p. 92)

Of this species it is stated that—

... data concerning over 300 moths were collected which bear evidence on the proportions of the sexes. These include records of moths collected in the field and of those bred out in the laboratory. In practically all cases there is a slight preponderance of females in the ratio of 168 females to 120 males.

## HEMILEUCA OLIVIAE COCKERELL (1, p. 84, 88)

In his paper on this species Mr. C. N. Ainslie says:

During the first week of emergence the males outnumbered the females at least three to one, and on page 88 a table shows that from 5,000 pupæ gathered in widely separated parts of the infested area there emerged 2,822 males as against 2,178 females.

Further information concerning this species is had from manuscript records on the relative proportions of the sexes, compiled from pupal parasite cages at Koehler, N. Mex., by Messrs. V. L. Wildermuth, D. J. Caffrey, and H. E. Smith, during September, October, and November, 1913. These records concern a total of 19,321 moths, of which 10,844 were males and 8,477 were females.

## PORTHETRIA DISPAR LINNAEUS

Under date of December 15, 1917, Mr. F. H. Mosher, Entomological Assistant, states that of the large number of gipsy moths reared in investigations extending over a period of six years the ratio of males to females averaged as 5 to 4, a percentage of 55.6 and 44.4, respectively.

A summing up of the foregoing notes on the proportional relations of the sexes in the Lepidoptera is presented in Table IV, by which it is seen that of 28,094 individuals, the males make up 55 per cent and the females 45 per cent. Although 14 species are concerned, the bulk of moths are of one species, *Hemileuca oliviae*. It is to be regretted that the matter of the proportion of sexes among Lepidoptera has received so little attention.

If it be assumed that the sexes exist in nature in approximately equal numbers, the investigations on which this paper is based show the females taken at the light trap to constitute 57 per cent of the assumed total of females, while the gravid females so taken make up 33 per cent. It is believed that further investigations to be conducted will adduce additional evidence to disprove the theory that practically only male

Lepidoptera are attracted to light traps and that of the females so captured all have previously oviposited.

TABLE IV.—Summary of foregoing records, compiled mainly from the literature, as to the relative proportions of male and female Lepidoptera

Species.	Number of males.	Number of females.	Total.	Percentage of males.	Percentage of females.
<i>Euproctis chrysorrhoea</i> Linnaeus.....	399	451	850	47	53
<i>Elasmopalpus lignosellus</i> Zeller.....	23	33	56	41	59
<i>Phthorimaea operculella</i> Zeller.....	327	284	611	53.5	46.5
<i>Crambus hortuellus</i> Hübner.....	41	19	60	68.3	31.7
<i>Plutella maculipennis</i> Curtis.....	26	26	52	50	50
<i>Carpocapsa pomonella</i> Linnaeus.....	576	713	1,289	44.7	55.3
<i>Hemileuca oliviae</i> Cockerell.....	13,666	10,655	24,321	56	44
<i>Sanninoidea opalescens</i> Henry Edwards.....	118	114	232	50.9	49.1
<i>Synanthedon pictipes</i> Grote and Robinson...	6	11	17	35.3	64.7
<i>Archips argyrosipila</i> Walker.....	114	117	231	49.4	50.6
<i>Archips rosaceana</i> Harris.....	35	27	62	56.5	43.5
<i>Halisidota caryae</i> Harris.....	17	8	25	68	32
<i>Chloridea obsoleta</i> Fabricius.....	120	168	288	42	58
<i>Porthetria dispar</i> Linnaeus.....				55.6	44.4

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