T H E S I S

RELATION OF INSECTS TO THE POLLINATION OF PEARS AND APPLES.

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THESIS

C O N T E N T S.

Relation of Insects to the Pollination of Pears and Apples.

Introduction.

It has long been known that many varieties of pears and apples are self-sterile while many other varieties do much better when cross-fertilized; as is shown by the work of M. B. Waite of the U. S. Dep't of Agriculture and F. A. Waugh of the Vermont Experiment Station.

Cross-pollination may take place in nature in any one of three ways namely:- by birds, by wind, and by insects. The work done by birds would be purely accidental and so insignificant. Since the pollen of pears and apples is sticky and heavy the wind can accomplish very little if anything. The great work of pollination then falls to the insects and it was with these facts in mind that this work on "The Relation of Insects to the Pollination of Pears and Apples" was taken up.

In carrying on this thesis the following divisions of the work have been considered and kept in mind throughout.

1. Number and names of insects found on pear and apple trees during the period of blooming.

2. Do the same insects work on the two fruits?

3. What proportion of the insects visit the flowers

systematically.

4. The effect of weather upon the different insects with reference to their working.

5. When our large orchards are in full bloom are there enough insects to go around.

We began collecting insects the first day that any pears were in blossom and the work was continued every day until the apples were out of bloom. While we did not collect all or any where near all the insects seen never the less the number of insects collected on the different days is we believe approximately proportional to the number working on the respective days.

The observations on the weather are taken from the official records kept by the Chemical Department of the College. While these are very valuable there are many things connected with them which are inaccurate and hinder us in drawing conclusions, as: for example on May 23 we do not know whether the .76 inches of rain came during the day or the night previous. So here is an error which can not be avoided.

We are indebted to Professor U. P. Hedrick for the general plan of the work, and many valuable suggestions. Also we wish to express our thanks to R. H. Pettit for assistance in identifying many of the specimens.

Table I.

Kinds and dates of

insects collected on pears in 1901.

Hemiptera:

Capsidae:-

May 6	2
" 7	1
" 8	2
" 9	1
" 10	4
" 11	3
" 14	6
" 15	3
" 17	2
Total	24

Corimelaenidae:-

May 7	3
" 8	9
" 10	5
" 11	13
" 13	1
" 14	3
" 15	5
" 16	1
Total	40
Grand Total	64

Diptera:-

Tipulidae:-

May 15----------1

Total----------1

Culicidae:

May 10----------1

Total----------1

Chironomidae:

May 13----------2

Total----------2

Bibionidae:

May 13----------1

" 14----------1

" 15----------3

Total----------5

Stratiomyiidae:

May 7----------1

" 10----------5

" 11----------2

" 13----------4

" 14----------5

" 15----------9

" 16----------1

Total---------27

Empididae:

May 10----------7

" 11----------2

May 13----------8

" 14----------19

" 15----------17

" 16----------4

Total----------57

Syrphidae:

May 9----------1

" 10----------1

Total----------2

Conopidae:

May 6----------5

" 8----------1

" 15----------3

Total----------9

Muscidae:

Tachininae:

May 3----------1

" 15----------3

Total----------4

Sarcophaginae:

May 15----------1

Total----------1

Dexiinae:

May 10----------2

" 13----------1

" 14----------2

Total----------5

Anthomyiinae:

May 8----------2
" 10----------4
" 11----------1
" 13----------5
" 14----------3
" 15----------2
" Total----------17

Acalyptrate Muscidae:

May 7----------1
" 10----------1
" 13----------1
Total----------3
Total----------30
Grand Total----------136

Coleoptera:-

Pselaphidae:-

May 6----------13
" 7----------2
" 11----------4
" 14----------3
Total----------22

Coccinellidae:-

Megilla maculata:-

May 6----------1
" 7----------2
" 8----------1

May 10----------5

" 11----------2

" 14----------9

" 15----------7

" 16----------1

Total----------28

Hippodamia parenthsis:

May 16----------1

Total----------1

Coccinella 9-notata.

May 4----------1

" 6----------1

" 7----------1

" 10----------1

" 15----------1

" 16----------1

Total---------6

Total----------35

Dermestidae:

Anthrenus scrophulariae:

May 4----------1

" 6----------1

" 7----------1

" 8----------2

" 14----------1

" 16----------2

Total---------8

Lampyridae:

May 15----------1

Total----------1

Scarabaeidae:

Aphodius inquinatus:

May 10----------1

Total----------1

Hoplia:

May 15----------1

Total----------1

Total----------2

Cerambycidae:

May 17----------1

Total----------1

Chrysomelidae:

Lina lapponica:

May 4----------2

Total----------2

Diabrotica:

May 7----------1

" 8----------1

" 14----------1

Total----------3

Unidentified:

May 11----------1

" 15----------1

Total----------2

Total--------------7

Bruchidae (?):-

May 8----------2

Total----------2

Grand Total---------81

Hymenoptera:-

Braconidae:-

May 4----------1

Total----------1

Vespidae:-

Vespa

May 15----------1

Total----------1

Polistes

May 4----------2

" 6----------1

" 15----------1

Total----------4

Total--------------5

Andrenidae:-

May 3----------17

" 4----------13

" 6----------20

" 7----------40

" 8----------4

" 9---------- 1

" 10----------21

May 11----------2

" 13----------1

" 14----------2

" 15----------40

" 16----------3

Total----------164

Apidae:-

Bombus virginicus:-

May 8----------2

Total----------2

Apis mellifica:

May 3----------1

" 4----------2

" 6----------3

" 7----------2

" 8----------2

" 10----------6

" 13----------1

" 15----------1

Total----------18

Unidentified:

May 6----------1

Total----------1

Total----------21

Grand Total-----191

Table II Summary of Table I.

Hemiptera	64	14%
Capsidae----------24		
Corimelaenidae-----40		
Diptera	134	29%
Tipulidae----------1		
Culicidae----------1		
Chironomidae---------2		
Bibionidae----------5		
Stratiomyiidae------27		
Empididae----------57		
Syrphidae---------- 2		
Conopidae----------9		
Muscidae----------30		
Coleoptera	78	17%
Pselaphidae---------22		
Coccinellidae-------35		
Dermestidae----------8		
Lampyridae----------1		
Scarabaeidae---------2		
Cerambycidae---------1		
Chrysomelidae--------7		
Bruchidae----------1		
Hymenoptera	191	40%
Braconidae ----------1		
Vespidae----------5		
Andrenidae----------21		
Apidae----------21		

This summary shows a total of 458 specimens collected representing four orders and twenty-three families. Of these we see that only nine families are represented by as many as ten specimens each and these nine families contain ninety-five percent (95%) of the insects collected. Fifty-eight percent (58%) of the insects collected belong to the three families Corimelaenidae, Stratiomyiidae, and Andrenidae and thirty-five percent (35%) belong to the Andrenidae. Fourteen percent (14%) belong to the Hemiptera, twenty-nine to the Diptera, seventeen to the Coleoptera and forty to the Hymenoptera.

In conclusion it may be said that the greater proportion of the insects that work on pears belong to the Diptera and Hymenoptera and of these the Hymenoptera are the more important.

Table III.

Kinds and dates of insects collected on apples in 1901.

Hemiptera:-

Acanthiidae:

May 20----------1

Total----------1

Capsidae:

May 10----------2
" 11----------1
" 14----------2
" 15----------1
" 16----------3
" 17----------1

Total----------10

Pentatomidae:

May 10----------1

Total----------1

Corimelaenidae:

May 9----------1
" 15----------1
" 16----------2
" 17----------6
" 23----------1

Total----------11

Aphididae:

May 22----------2

Total----------2

Grand Total----------25

Tricoptera:

May ----------1

Grand Total----------1

Diptera:

Tipulidae:

May 10----------1

" 11----------1

Total----------2

Culicidae:

May 13----------1

" 20----------1

Total----------2

Chironomidae:

May 20----------1

" 22----------1

Total----------2

Mycetophilidae:

May 17----------1

" 18----------1

" 22----------2

Total----------4

Bibionidae:

May 10----------1

May 15----------2
" 16----------3
" 20----------1
" 22----------1
" 23----------3

Total----------11

Simuliidae:

May 23----------1

Total----------1

Stratiomyiidae:

May 10----------2
" 13----------1
" 15----------3
" 16----------10
" 17----------5
" 18----------2
" 20----------4
" 22----------3
" 23----------7
" 27----------3

Total----------40

Empididae:

May 10----------4
" 11----------1
" 13----------1
" 14----------5
" 15----------5

May 16----------6

" 17----------7

" 18----------2

" 20----------6

" 23----------10

" 27----------1

Total----------48

Syrphidae:

May 7----------1

" 13----------1

" 20----------1

" 22----------2

" 27----------2

Total----------7

Conopidae:

May 15----------1

Total----------1

Muscidae:

Tachininae:

May 13----------1

" 14----------1

" 15----------2

" 16----------1

" 17----------1

" 20----------2

Total----------8

Sarcophaginae:

May 14----------1

Total----------1

Dexiinae:

May 14----------1

" 15----------1

" 20----------2

Total----------4

Anthomyiinae:

May 10----------2

" 11----------3

" 13----------1

" 14----------4

" 15----------2

" 16----------1

" 17----------1

" 18----------1

" 20----------1

" 22----------2

" 23----------4

Total----------22

Acalyptrate Mucidae:

May 14----------1

" 22----------1

" 27----------1

Chaetopiisaenea

May 23----------1

Total----------4

Total----------39

Grand Total--------157

Coleoptera:

Coccinellidae:

Megilla maculata:

May 10----------1

" 13----------1

" 14----------8

" 16----------1

" 17----------4

" 20----------2

Total----------17

Hippodamia parenthsis:

May 16----------1

" 18----------1

Total----------2

Coccinella 9 - notata:

May 10----------3

" 14----------1

" 15----------4

" 16----------2

" 17----------1

" 18----------3

" 20----------1

" 22----------2

Total----------17

Adalia frigida:

May 17----------1

" 23----------1

Total----------2

Anatis 15- punctata:

May 10----------1

" 14----------1

" 15----------2

" 17----------1

" 23----------1

Total----------6

Chilcornus bivulnerus:

May 14----------1

Total----------1

Total---------- --45

Cleridae:

May 23----------1

Total----------1

Scarabaeidae:

Euphoria inda---

May 10----------1

Total----------1

Grand Total----------47

Hymenoptera:

Formicidae:

May 10----------2

" 11----------1

May 15----------2

" 16----------2

" 27----------1

Total----------8

Vespidae:

Polistes:

May 17----------1

" 18----------1

Total----------2

Andrenidae:

Agapostermon:

May 15----------1

" 16----------2

" 17----------1

" 18----------5

" 23----------2

Total----------11

Nomada belfragei:?

May 10----------1

" 16----------1

" 23----------1

Total----------3

Unidentified:

May 7----------8

" 9----------1

" 10----------18

" 11----------9

" 13----------2

May 14----------3

" 15----------56

" 16----------34

" 17----------39

" 18----------20

" 20----------8

" 22----------23

" 23----------29

" 27----------6

Total----------258

Total----------272

Apidae:

Bombus virginicus:

May 7----------1

" 11----------1

" 13----------2

" 14----------1

" 15----------2

" 16----------1

" 17----------2

" 18----------1

" 20----------1

" 22----------1

" 23----------2

Total----------15

Bombus separatus:-

May 7----------1

" 15----------2

" 16----------1

" 17----------1

" 18----------1

" 22----------1

Total----------7

Bombus pennsylvanicus:

May 7----------1

" 10----------1

" 15----------2

" 22----------1

" 23----------1

Total----------6

Bombus feridus:

May 16----------1

" 22----------1

" 23----------1

Total----------3

Total----------31

Apis mellifica:

May 11----------2

" 13----------1

" 14----------6

" 15----------8

" 16----------5

May 17----------8

" 18----------3

" 20----------8

" 22----------4

" 23----------1

" 27----------2

Total----------48

Grand Total---------79

Table IV. Summary of Table III.

Hemiptera	25	4%
Acanthiidae---------1		
Capsidae----------10		
Pentatomidae--------1		
Corimelaenidae-----11		
Aphididae----------2		
Tricoptera----------1	1	
Diptera	157	27%
Tipulidae----------2		
Culicidae----------2		
Chironomidae--------2		
Mycetophilidae------4		
Bibionidae---------11		
Simuliidae----------1		
Stratiomyiidae-----40		
Empididae----------48		

Syrphidae----------7

Conopidae----------1

Muscidae----------39

Coleoptera---------- ----------47 8%

Coccinellidae------45

Cleridae----------1

Searabaeidae-------1

Hymenoptera----------361 61%

Formicidae---------8

Vespidae----------2

Andrenidae--------272

Apidae------------79

This summary shows a total of 592 specimens collected on apples represent twenty-five families. But of these we see that only nine families are represented by as many as ten specimens each and these nine families contain ninety-five percent (95%) of the insects collected. (Same as on pears). Ninety percent (90%) of the insects belong to the six families, Stratiomyiidae, Empididae, Muscidae, Coccinellidae, Andrenidae, and Apidae; while forty-six percent (46%) belong to the Andrenidae and thirteen percent (13%) to the Apidae. Four percent (4%) belong to the Hemiptera, twenty-seven percent (27%) to the Diptera, eight percent (8%) to the Coleoptera and sixty-one percent (61%) to the Hymenoptera.

In conclusion then it may be said that by far the

greater proportion of insects which work on apples belong to the Diptera and Hymenoptera and the majority of all such insects belong to the Hymenoptera.

Tables II and IV combined showing in parallel columns the families of insects that worked on the two fruits in 1901.

Pears	No. of specimens	Apples	No. of specimens
Hemiptera	64	Hemiptera	25
		Acanthiidae	1
Capsidae	24	Capsidae	10
		Pentitomidae	1
Corimelaenidae	40	Corinelaenidae	11
		Aphididae	1
		Tricoptera	1
Diptera	135	Diptera	157
Tipulidae	1	Tipulidae	2
Culicidae	1	Culicidae	2
Chironomidae	2	Chironomidae	2
		Mycetophilidae	4
Bibionidae	5	Bibionidae	11
		Simuliidae	1
Stratiomyiidae	27	Stratiomyiidae	40
Empididae	57	Empididae	48
Syrphidae	2	Syrphidae	7
Conopidae	9	Conopidae	1
Muscidae	30	Muscidae	39
Coleoptera	81	Coleoptera	47
Pselaphidae	22		
Coccinellidae	35	Coccinellidae	45
Dermistidae	8		
Lampyridae	1		

Pears	No. of specimens	Apples	No. of specimens
		Cleridae	1
Scarabaeidae	2	Scarabaeidae	1
Cerambycidae	1		
Chrysomelidae	7		
Bruchidae	2		
Hymenoptera	191	Hymenoptera	361
Braconidae	1		
		Formicidae	8
Vespidae	5	Vespidae	2
Andrenidae	164	Andrenidae	272
Apidae	21	Apidae	79

We found nearly the same number of families on both pears and apples, but some families work on pears and not on apples and vice verse.

Two families of Diptera were collected on pears and three more on apples, but they are of little importance since a total of only four specimens were found.

One specimen of Tricoptera was collected on apples and none of pears.

Nine families of Diptera were collected on pears, all of which were found on apples. Eleven families were collected on apples, two of each were not found on pears, but they are of little importance as a total of only five specimens were collected.

Eight families of Coleoptera were collected on pears,

only two of which were found on apples. Three families of Coleoptera were collected on apples, one of which represented by one specimen was found on apples only.

Four families of Hymenoptera were collected on pears and three of them were found on apples. One family represented by one specimen was found on pears, but not on apples. One family represented by eight specimens was collected on apples and not found on pears.

By a further comparison of these summaries we find that the percent of Hemiptera found on pears is three and one-half times that of the same insects found on apples. The proportion of Diptera is approximately the same on the two kinds of fruit. The proportion of Coleoptera is twice as great on pears as on apples. But with regard to the Hymenoptera the proportion is much greater on apples than on pears.

Table VI.

A classification of the insects on the two fruits in 1901 according to character of work done in pollination.

A. Insects that carry pollen only accidentally.

I. Those that get on the flowers only accidentally.

	Pears	Apples
Hemiptera		
Acanthiidae		1
Pentatomidae		1
Aphididae		2
Tricoptera		1
Diptera		
Tipulidae	1	2
Culicidae	1	2
Mycetophilidae		4
Simulidae		1
Coleoptera		
Coccinellidae	35	45
Lampyridae	1	
Cleridae		1
Scarabaeidae	2	1
Cerambycidae	1	
Chrysomelidae	7	
Bruchidae	1	
Hymentoptera		
Braconidae	1	
	(49) 9%	(70) 12%

II. Those that visit the flowers systematically but carry pollen only accidentally.

	Pears		Apples	
Hemiptera				
Capsidae	24		10	
Corimelaenidae	40		11	
Diptera				
Chironomidae	2		2	
Bibionidae	5		11	
Stratiomyiidae	27		40	
Empididae	57		48	
Syrphidae	2		7	
Conopidae	9		1	
Muscidae	30		39	
Coleoptera				
Pselaphidae	22			
Dermestidae	8			
Hymenoptera				
Formicidae			8	
Vespidae	5		2	
	225	51%	171	28%

Vegetables	5
Tomatoes	
Green beans	
Peas	8
Corn	9
Spinach	3
Cauliflower	27
Broccoli	5
Cabbage	40
Fruits	
Watermelon	2
Apples	5
Peaches	27
Pears	5
Grapes	3
Berries	10
Miscellaneous	
Honey	1
Nuts	2
Dried beans	
Dried peas	
Soybeans	
Sugar	
Maple syrup	
Other	

B. Those that visit flowers and carry pollen systematically.

Hymenoptera				
Andrenidae	164		272	
Apidae	21		79	
	185	40%	359	60%

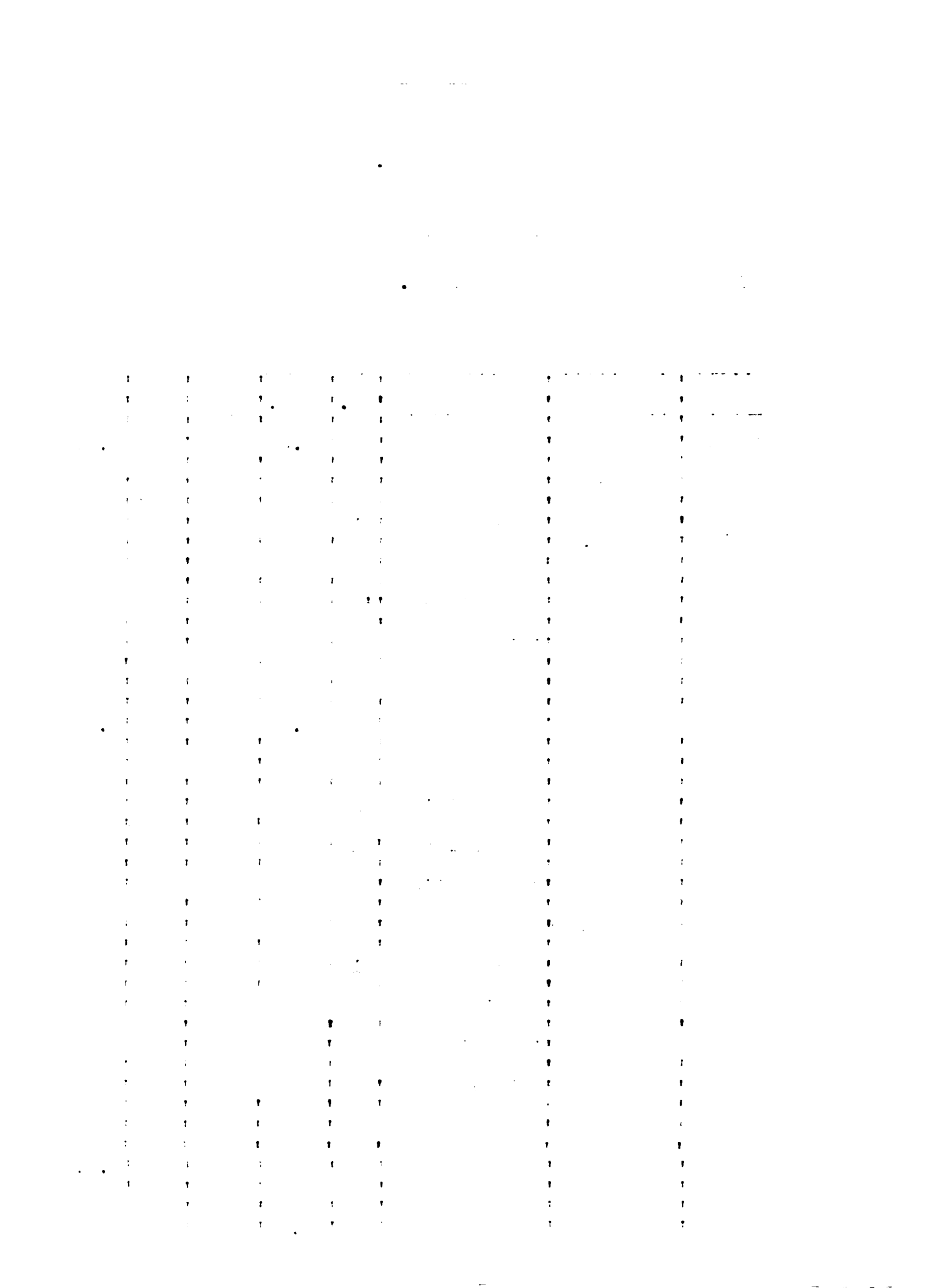
From this table we see that the only insects that are of any particular value to the orchardist in assisting in pollination are the Andrenidae and Apidae.

The proportion of the different classes can readily be seen from the table.

Table VII.

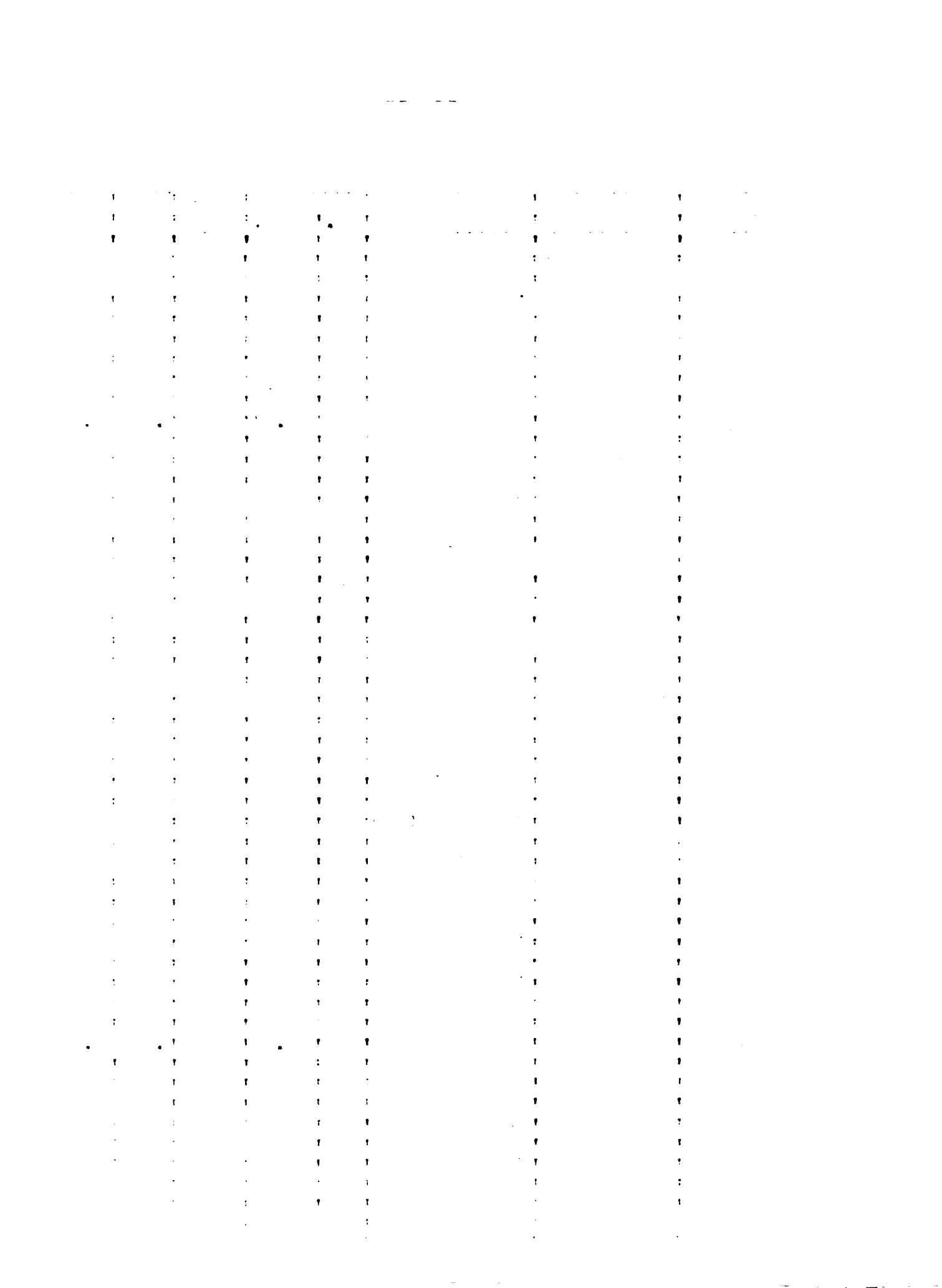
Dates and Families of insects collected together with weather reports for 1901.

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 3			19	51.3°	100%	0	N.E.5
	Diptera		1				
		Muscidae	1				
	Hymenoptera		18				
		Andrenidae	17				
		Apidae	1				
May 4			22	59.3	100%	0	S.5
	Coleoptera		4				
		Coccinellidae	1				
		Dermestidae	1				
		Chrysomelidae	2				
	Hymenoptera		18				
		Braconidae	1				
		Vespidae	2				
		Andrenidae	13				
		Apidae	2				
May 5			0	65 1/3	80%	0	S.E.3
May 6			53	64.6	30%	0	E.7



Date	Order	Family	No.	Temp	Sun-shine	Rain	Wind
May 6	Hemiptera		2				
		Capsidae	2				
	Diptera		5				
		Conopidae	5				
	Coleoptera		21				
		Pselaphidae	13				
		Coccinellidae	7				
		Dermestidae	1				
	Hymenoptera		25				
		Vespidae	1				
		Andrenidae	20				
		Apidae	4				
May 7			66	61.6°	40%	.01	S.7
	Hemiptera		4				
		Capsidae	1				
		Corimelaenidae	3				
	Diptera		2				
		Stratiomyiidae	1				
		Muscidae	1				
	Coleoptera		7				
		Pselaphidae	2				
		Coccinellidae	3				
		Dermestidae	1				
		Chrysomelidae	1				

Date	Order	Family	No.	Temp.	Sun-Shine	Rain	Wind
May 7	Hymenoptera		53				
		Andrenidae	48				
		Apidae	5				
May 8			28	58.6°	0	.69	S.
	Hemiptera		11				
		Capsidae	2				
		Corimelaenidae	9				
	Diptera		3				
		Conopidae	1				
		Muscidae	2				
	Coleoptera		6				
		Coccinellidae	1				
		Dermestidae	2				
		Chrysomelidae	1				
		Bruchidae	2				
	Hymenoptera		8				
		Andrenidae	4				
		Apidae	4				
May 9			5	58.6°	0	.24	E.
	Hemiptera		2				
		Capsidae	1				
		Corimelaenidae	1				
	Diptera		1				
		Syrphidae	1				



Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 9	Hymenoptera		2				
		Andrenidae	2				
May 10			105	61°	75%	0	S.E.
	Hemiptera		12				
		Capsidae	6				
		Pentatomidae	1				
		Corimelaenidae	5				
	Diptera		31				
		Tipulidae	1				
		Culicidae	1				
		Bibionidae	1				
		Stratiomyiidae	7				
		Empididae	11				
		Syphidae	1				
		Muscidae	9				
	Coleoptera		13				
		Coccinellidae	11				
		Scarabaeidae	2				
	Hymenoptera		49				
		Formicidae	2				
		Andrenidae	40				
		Apidae	7				
May 11			49	53.6°	80%	.16	W.
	Hemiptera		17				
		Capsidae	4				
		Corimelaenidae	13				

Date	Order	Family	No.	Temp.	Sunshine	Rain	Wind
May 11	Diptera		10				
		Tipulidae	1				
		Stratiomyiidae	2				
		Empididae	3				
		Muscidae	4				
	Coleoptera		7				
		Pselaphidae	4				
		Coccinellidae	2				
		Chrysomelidae	1				
	Hymenoptera		15				
		Formicidae	1				
		Andrenidae	11				
		Apidae	3				
May 12				40.6°	60%	.14	W
May 13			49	47°	80%	0	W.
	Hemiptera		13				
		Corimelaeidae	13				
	Diptera		28				
		Culicidae	1				
		Chironomidae	2				
		Bibionidae	1				
		Stratiomyiidae	5				
		Empididae	9				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 13		Syrphidae	1				
		Muscidae	9				
	Hymenoptera		7				
		Andrenidae	3				
		Apidae	4				
May 14			91	46.3°	95%	0	N.W.3
	Hemiptera		11				
		Capsidae	8				
		Corimelaenidae	3				
	Diptera		43				
		Bibionidae	1				
		Stratiomyiidae	5				
		Empididae	24				
		Muscidae	13				
	Coleoptera		25				
		Pselaphidae	3				
		Coccinellidae	20				
		Dermestidae	1				
		Chrysomelidae	1				
	Hymenoptera		12				
		Andrenidae	5				
		Apidae	7				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 15			196	53.6°	100%	0	S.W.3
	Hemiptera		10				
		Capsidae	4				
		Corimelaenidae	6				
	Diptera		54				
		Bibionidae	5				
		Stratiomyiidae	12				
		Empididae	22				
		Conopidae	4				
		Muscidae	11				
	Coleoptera		16				
		Coccinellidae	14				
		Lampyridae	1				
		Scarabaeidae	1				
	Hymenoptera		116				
		Formicidae	2				
		Vespidae	2				
		Andrenidae	97				
		Apidae	15				
May 16			90	62°	90%	0	S.4
	Hemiptera		6				
		Capsidae	3				
		Corimelaenidae	3				
	Tricoptera		1				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 16	Diptera		26				
		Bibionidae	3				
		Stratiomyiidae	11				
		Empididae	10				
		Muscidae	2				
	Coleoptera		7				
		Coccinellidae	7				
	Hymenoptera		50				
		Formicidae	2				
		Andrenidae	40				
		Apidae	8				
May 17			84	65.3°	10%	.07	S.W.7
	Hemiptera		9				
		Capsidae	3				
		Corimelaenidae	6				
	Diptera		15				
		Mycetophilidae	1				
		Stratiomyiidae	5				
		Empididae	7				
		Muscidae	2				
	Coleoptera		8				
		Cocinellidae	7				
		Cerambycidae	1				
	Hymenoptera		52				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
		Vespidae	1				
		Andrenidae	40				
		Apidae	11				
May 18			41	59.6°	60%	0	N.E.4
	Diptera		6				
		Mycetophilidae	1				
		Stratiomyiidae	2				
		Empididae	2				
		Muscidae	1				
	Coleoptera		4				
		Coccinellidae	4				
	Hymenoptera		31				
		Vespidae	1				
		Andrenidae	25				
		Apidae	5				
May 19				52.6°	0	.02	N.E.6
May 20			41	53.6°	0	0	N.E.7
	Hemiptera		1				
		Acanthiidae	1				
	Diptera		19				
		Culicidae	1				
		Chironomidae	1				
		Bibionidae	1				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 20		Stratiomyiidae	4				
		Empididae	6				
		Syrphidae	1				
		Muscidae	5				
	Coleoptera		3				
		Coccinellidae	3				
	Hymenoptera		17				
		Andrenidae	8				
		Apidae	9				
May 21				56.6°	0	.29	N.E.13
May 22			47	59.3°	40%	0	S.W.12
	Hemiptera		2				
		Aphididae	2				
	Diptera		12				
		Chironomidae	1				
		Mycetophilidae	2				
		Bibionidae	1				
		Stratiomyiidae	3				
		Syrphidae	2				
		Muscidae	3				
	Coleoptera		2				
		Coccinellidae	2				
	Hymenoptera		31				
		Andrenidae	23				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
		Apidae	8				
May 23			66	67.3°	85%	.76	S.W.8
	Hemiptera		1				
		Corimelaenidae	1				
	Diptera		26				
		Bibionidae	3				
		Simuliidae	1				
		Stratiomyiidae	7				
		Empididae	10				
		Muscidae	5				
	Coleoptera		2				
		Coccinellidae	1				
		Cleridae	1				
	Hymenoptera		37				
		Andrenidae	32				
		Apidae	5				
May 24				53.6°	0	0	N.E.12
May 25				50°	0	0	N.11
May 26				47.6°	0	0	N.9
May 27			16	55.6°	60%	0	N.10
	Diptera		7				
		Stratiomyiidae	3				
		Empididae	1				
		Syrphidae	2				
		Muscidae	1				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 27	Hymenoptera		9				
		Formicidae	1				
		Andrenidae	6				
		Apidae	2				

Conclusion.

Hemiptera.--As far as this order is concerned we can find no definite relation between either the sunshine, temperature, or rainfall and the number of specimens found.

Diptera.--Sunshine seems to have a greater influence on the number of specimens found than temperature, but rainfall prevents their working.

Coleoptera.--The higher the temperature the more specimens found. No relation between sunshine and specimens.

Hymenoptera.--The warmer the day the more specimens found. Sunshine same as temperature. Rainfall lessens number of insects found.

In general the warmer the day and the more sunshine the greater the number of insects moving.

Introduction to work of 1902.

As there is a great difference in insects from one year to another as well as in the weather, and owing to chances for error in last year's work the idea this year was to repeat for a check about the same work as was done last spring attempting however greater accuracy. The methods of work were the same as previously. More careful records were kept of the weather and one hour was spent each day collecting on each fruit.

Table VIII.

Kinds and dates of
insects collected on pears in 1902.

Hemiptera:-

Acanthiidae.

May 14----------1

Total----------1

Capsidae:

May 3----------1
" 5----------3
" 6----------2
" 7----------2
" 8----------2
" 9----------2
" 11----------1
" 12----------3
" 16----------1

Total----------17

Pentatomidae:

Cosmopepla carnifex:

May 16----------1

Total----------1

Unidentified:

May 3----------1

May 4----------1

" 5----------1

" 6----------1

" 8----------1

" 16----------1

Total----------6

Total----------7

Corimelaenidae:

May 4----------1

" 17----------1

Total----------2

Grand Total----------27

Neuroptera:

May 3----------1

Grand Total----------1

Tricoptera:

May 6----------1

Grand Total----------1

Diptera:

Chironomidae:

May 6----------2

Total----------2

Mycetophilidae:

May 4----------2

" 8----------1

" 12----------3

" 13----------3

May 14----------1

Total----------10

Bibionidae:

May 13----------1

" 14----------2

Total----------3

Tabanidae:

May 15----------1

Total----------1

Stratiomyiidae:

May 3----------1

" 5----------6

" 6----------1

" 7----------5

" 8----------11

" 9----------1

" 12----------3

" 13----------2

" 14----------8

" 15----------5

" 16----------15

" 17----------6

Total----------64

Empididae:

May 3----------1

" 5----------3

" 6----------1

" 9----------1

Empididae: (cont.)

May 11----------2
" 12----------19
" 13----------15
" 14----------26
" 15----------18
" 16----------3
" 17----------13
" 19----------3

Total----------105

Syrphidae:

May 2----------3
" 3----------1
" 4----------2
" 5----------7
" 6----------3
" 7----------2
" 8----------20
" 9----------1
" 11----------9
" 12----------5
" 13----------1
" 14----------3
" 15----------3

Total----------60

Conopidae:

May 5----------1
" 12----------2

Conopidae (cont.):

May 15----------1

Total----------4

Muscidae:

Tachininae:

May 8----------2

" 11----------1

" 14----------1

" 17----------1

Total----------5

Sarcophaginae:

May 8----------2

" 11----------2

" 12----------2

" 15----------1

Total----------7

Dexiinae:

May 11----------1

" 12----------1

" 14----------2

" 16----------1

Total----------5

Muscinae:

May 14----------2

" 16----------2

Total----------4

Anthomyiinae:

May 5----------2

Anthomyiinae: (cont.)

May 7----------2
" 8----------5
" 9----------1
" 11----------3
" 12----------2
" 13----------3
" 14----------2
" 15----------7
" 16----------5
" 17----------2

Total----------34

Total----------55

Grand Total----------304

Coleoptera:

Coccinellidae:

Megilla maculata:

May 3----------1
" 4----------1
" 5----------1
" 6----------5
" 7----------10
" 8----------2
" 9----------1
" 11----------1
" 12----------4
" 14----------3
" 15----------1

Megilla maculate: (cont.)

May 16----------1

" 17----------1

" Total----------35

Hippodamia parenthsis:

May 15----------1

Total----------1

Coccinella 9-notata:

May 5----------1

" 6----------1

" 7----------1

" 8----------1

" 12----------2

" 14----------2

" 15----------1

" 16----------1

Total----------10

Adalia figida:

May 12----------1

Total----------1

Chilocorus bivulnerus:

May 13----------1

Total----------1

Total----------48

Dermestidae:

Anthrenus scrophulariae:

May 3----------22

" 12----------5

" 13----------1

" 14----------2

" 15----------8

" 16----------16

" 17----------20

" 19----------1

Total----------75

Total----------75

Elateridae:

May 7----------1

" 16----------1

Total----------2

Lampyridae:

May 12----------1

Total----------1

Cerambycidae:

May 5----------2

" 12----------1

" 14----------2

" 15----------1

" 16----------3

" 17----------2

" 19----------2

Total----------13

Chrysomelidae:

Lina lapponica:

May 4----------1

" 16----------1

Total----------2

Odontata narvosa:

May 17----------1

Total----------1

Undetermined:

May 14----------1

Total----------1

Total----------4

Curculionidae:

May 17----------1

Total----------1

Grand Total----------144

Hymenoptera:

Ichneumonidae:

May 3----------1

" 7----------1

Total----------2

Formicidae:

May 3----------1

" 4----------1

" 5----------2

" 12----------3

" 14----------1

Formicidae:(cont)

May 16----------1

" 17----------1

Total----------10

Vespidae:

Polistes:

May 3----------4

" 4 ----------2

" 5----------3

" 12----------2

" 15----------2

Total----------13

Crabro:

May 16----------1

Total----------1

Total----------14

Andrenidae:

Nomada:

May 3----------3

" 12----------1

Total----------4

Agapostemon:

May 8----------1

" 12----------1

" 17----------2

Total----------4

Unidentified:

May 2----------6
" 3----------30
" 4----------24
" 5----------32
" 6----------12
" 7----------2
" 8----------85
" 11----------9
" 12----------79
" 13----------2
" 14----------33
" 15----------39
" 16----------32
" 17----------9
" 19----------1

Total---------394

Total----------402

Apidae:

Xylocopa virginica:

May 4----------1

Total----------1

Bombus virginicus:

May 3----------1
" 12----------1

Total----------2

Apis mellifica:

May 3----------1

Apis mellifica (cont.)

May 4----------9

" 5----------12

" 6----------16

" 7----------7

" 8----------18

" 9----------4

" 11----------21

" 12----------9

" 13----------3

" 14----------12

" 15----------1

" 16----------3

Total----------116

Total----------119

Grand Total---------547

Table IX.

Summary of Table VIII.

Hemiptera:		27	2.6%
Acanthiidae	1		
Capsidae	17		
Pentatomidae	7		
Corimelaenidae	2		
Neuroptera	1	1	
Tricoptera	1	1	
Diptera		304	30%

Chironomidae----------2

Mycetophilidae----------10

Bibionidae----------3

Tabanidae----------1

Stratiomyiidae----------64

Empididae----------105

Syrphidae----------60

Conopidae----------4

Muscidae----------55

Coleoptera----------144 14%

Coccinellidae----------48

Dermestidae----------75

Elateridae----------2

Lampyridae----------1

Cerambycidae----------13
Chrysomelidae----------4
Curculionidae----------1

Hymenoptera----------547 53.4%

Ichneumonidae----------2

Formicidae----------10

Vespidae----------14

Andrenidae----------402

Apidae----------119

This summary shows a total of 1024 specimens collected, representing six orders and twenty-seven families; but of these only thirteen families are represented by as many as ten specimens each and these thirteen

families contain 97% of the insects collected. 61% of the insects belong to the three families Empididae, Andrenidae and Apidae and 39.2% belong to the Andrenidae alone. 2.6% belong to the Hemiptera, 30% to the Diptera, 14% to the Coleoptera, and 53.4% to the Hymenoptera. We would say from observation that these figures represent about the proportional number of the different insects working.

In conclusion it may be said that the greater proportion of the insects that work on pears belong to the Diptera and Hymenoptera and of these the Hymenoptera are far the more important.

Table X.

Kinds and dates of

insects collected on Apples in 1902.

Hemiptera:-

Acanthiidae:

May 13----------1

" 14----------1

" 17----------1

Total----------3

Capsidae:

May 6----------2

" 12----------5

" 15----------2

" 17----------2

" 19----------2

" 21----------2

Total----------15

Lygaeidae:

May 7----------1

Total----------1

Pentatomidae:

May 6----------1

Total----------1

Grand Total---------20

Tricoptera:

May 8----------1

" 12----------1

Total----------2

Grand Total---------2

Lepidoptera:

May 20--------------------1

Total----------1

Grand Total---------1

Diptera:

Chironomidae:

May 6--------------------1

" 12--------------------1

Total----------2

Mycetophilidae:

May 12--------------------1

" 13--------------------1

" 14--------------------2

" 15--------------------2

" 16--------------------1

" 17--------------------1

Total----------8

Bibionidae:

May 12--------------------3

" 13--------------------1

" 14--------------------1

" 15--------------------2

" 16--------------------1

" 17--------------------4

" 21--------------------1

Total----------13

Stratiomyiidae:

May 6----------1
" 8----------3
" 11----------1
" 12----------2
" 13----------1
" 14----------1
" 15----------3
" 16----------2
" 17----------9
" 19----------5
" 20----------4
" 21----------3

Total----------35

Empididae:

May 11----------1
" 12----------2
" 13----------1
" 14----------10
" 16----------15
" 17----------7
" 19----------5
" 20----------7
" 21----------5

Total----------53

Syrphidae:

May 6----------3
" 8----------3

May 11----------3

" 12----------2

" 14----------3

" 15----------2

" 16----------1

" 17----------1

" 19----------2

Total----------20

Conopidae:

May 8----------3

" 15----------1

" Total----------4

Muscidae:

Tachininae:

May 11----------1

" 15----------2

Total----------3

Sarcophaginae:

May 6----------1

" 9----------1

" 11----------1

" 14----------1

" 17----------1

Total----------5

Anthomyiinae:

May 6----------4
" 7----------1
" 8----------2
" 9----------3
" 11----------9
" 12----------10
" 14----------4
" 15----------6
" 16----------4
" 17----------5
" 20----------5

Total----------53

Total----------61

Grand Total----------196

Coleoptera:

Carabidae:

May 12----------1
" 19----------1

Total----------2

Coccinellidae:

Megilla maculata:

May 6----------1
" 7----------1
" 8----------2
" 15----------1
" 17----------1
" 19----------2

Total----------8

Hippodamia 13- punctata:

May 12----------1

" 14----------2

Total----------3

Hippodamia parenthsis:

May 12----------1

Total----------1

Coccinella 9-notata:

May 7----------1

" 8----------3

" 14----------1

" 15----------1

" 17----------1

" 19----------1

" 20----------4

" 21----------2

Total----------14

Adalia frigida:

May 9----------1

" 19----------1

Total----------2

Anatis 15-punctata:

May 19----------1

Total----------1

Chilocorus bivulnerus:

May 19----------1

Total----------1

Total----------30

Dermestidae:

Anthrenus scrophulariae:

May 19----------1

" 20----------6

" 21----------1

Total----------8

Total----------8

Scarabaeidae:

May 12----------1

Total----------1

Cerambycidae;

May 19----------2

" 20----------3

Total----------5

Grand Total---------46

Hymenoptera:

Ichneumonidae:

May 16----------1

" 17----------1

Total----------2

Formicidae:

May 15----------1

" 20----------1

Total----------2

Vespidae:

Polistes:

May 7----------1

" 20----------1

Total---------2

Total----------2

Andrenidae:

Nomada:

May 20----------3

" 21----------1

Total ---------4

Agapostermon:

May 8----------1

" 12----------1

" 15----------1

" 17----------2

" 19----------9

" 20----------4

Total---------18

Unidentified:

May 6----------8

" 7----------5

" 8----------90

" 11----------7

Unidentified (cont.)

May 12----------63

" 14----------20

" 15----------46

" 16----------41

" 17----------65

" 19----------108

" 20----------71

" 21----------16

Total----------540

Total----------562

Apidae:

Xylocopa virginica:

May 8----------2

Total----------2

Bombus Virginicus:

May 6----------4

" 7----------6

" 8----------4

" 9----------5

" 11----------2

" 12----------5

" 14----------2

" 15----------2

" 16----------2

" 17----------6

Bombus Virginicus (cont.)

May 19----------2
" 20----------2
" 21----------2

Total----------44

Bombus separatus:

May 7----------1
" 12----------1
" 14----------1
" 15----------5
" 16----------3
" 17----------1

Total----------12

Bombus pennsylvanicus:

May 8----------1
" 11----------1
" 14----------1
" 16----------3
" 17----------1
" 19----------1
" 20----------1

Total----------9

Bombus feridus:

May 15----------2
" 17----------2
" 19----------1
" 20----------1

Total----------6

Apis mellifica:

May	6	6
"	7	8
"	8	5
"	9	4
"	11	20
"	12	28
"	13	1
"	14	21
"	15	40
"	16	39
"	17	44
"	19	11
"	20	10
	Total	237

Unidentified:

May	16	1
	Total	1
	Total	311
	Grand Total	879

Table XI.

Summary of Table X.

Hemiptera:	20	1.7%
Acanthiidae	3	
Capsidae	15	
Lygaeidae	1	
Pentatomidae	1	
Tricoptera	2	2
Lepidoptera	1	1
Diptera	196	17.1%
Chironomidae	2	
Mycetophilidae	8	
Bobionidae	13	
Stratiomyiidae	35	
Empididae	53	
Syrphidae	20	
Conopidae	4	
Muscidae	61	
Coleoptera	46	4.%
Carabidae	2	
Coccinellidae	30	
Dermestidae	8	
Scarabaeidae	1	
Cerambycidae	5	
Hymenoptera	879	76.9%
Ichneumonidae	2	
Formicidae	2	

Hymenoptera-(cont.)

Vespidae----------2

Andrenidae--------562

Apidae------------311

This summary shows a total of 1144 specimens collected representing six orders and twenty-four families; but of these only nine families are represented by as many as ten specimens each, and these nine families contain 96.1% of the insects collected. 49.1% belong to the Andrenidae and 27.2% to the Apidae. 1.7 belong to the Hemiptera 17.1% to the Diptera, 4.% to the Coleoptera and 76.9% to the Hymenoptera.

From observations we would say that these figures are inaccurate so there was apparently as many Apidae as Andrenidae working. The difference in numbers collected is probably due to difference in the habits of the two families making necessary different methods of collecting. The Andrenidae generally work high up on the trees and are easily disturbed. They were caught mainly by shaking the trees and then sweeping with a long handled net. The Apidae on the other hand work about equally on all parts of the trees but are not easily disturbed and so were collected for the most part individually.

Tables IX and XI combined showing in parallel columns the families of insects that worked on the two fruits in 1902.

Pears	No. of specimens	Apples	No. of specimens
Hemiptera 2.6%	27	Hemiptera 1.7%	20
Acanthiidae	1	Acanthiidae	3
Capsidae	17	Capsidae	15
		Lygaeidae	1
Pentatomidae	7	Pentatomidae	1
Corimelaenidae	2		
Neuroptera	1		
Tricoptera	1	Tricoptera	2
		Lepidoptera	1
Diptera 30%	304	Diptera 17.1%	196
Chironomidae	2	Chironomidae	2
Mycetophilidae	10	Mycetophilidae	8
Bibionidae	3	Bibionidae	13
Tabanidae	1		
Stratiomyiidae	64	Stratiomyiidae	35
Empididae	105	Empididae	53
Syrphidae	60	Syrphidae	20
Conopidae	4	Conopidae	4
Muscidae	55	Muscidae	61
Coleoptera 14%	144	Coleoptera 4%	46
		Carabidae	2
Coccinellidae	48	Coccinellidae	30

Pears	No. of specimens	Apples	No. of specimens
Dermestidae	75	Dermestidae	8
Elateridae	2		
Lampyridae	1		
		Scarabaeidae	1
Cerambycidae	13	Cerambycidae	5
Chrysomelidae	4		
Curculionidae	1		
Hymenoptera 53.4%	547	Hymenoptera 76.9%	879
Ichneumonidae	2	Ichneumonidae	2
Formicidae	10	Formicidae	2
Vespidae	14	Vespidae	2
Andrenidae	402	Andrenidae	562
Apidae	119	Apidae	311

We find nearly the same number of families on both pears and apples, but some families work on pears and not on apples and vice verse.

Three families of Hemiptera were found on both pears and apples. One family represented by two specimens was found on pears and not on apples. One family represented by one specimen was found on apples and not on pears.

One specimen of Neuroptera was collected on pears and none on apples.

Tricoptera were found on both pears and apples.

One specimen of Lepidoptera was collected on apples and a few others were seen, but none were observed on pears

Nine families of Diptera were collected on pears, only one of which was not found on apples.

Seven families of Coleoptera were collected on pears, only one of which was found on apples. One family represented by one specimen was found on apples and not on pears. The families of Coleoptera not common to both pears and apples were not abundant.

Five families of Hymenoptera were collected on both fruits.

By a further comparison of these summaries we find that the percent of Hemiptera is about one-half greater on pears than on apples. The proportion of Diptera is considerably greater on pears than on apples. There were three and one-half times as many Coleoptera on pears as on apples. The Hymenoptera however, were far more abundant on apples than on pears.

A classification of the insects on the two fruits in 1902 according to character of work done in pollination.

A. Insects that carry pollen only accidentally.

I. Those that get on the flowers only accidentally.

	Pears		Apples.
Hemiptera			
Acanthiidae	1		3
Lygaeidae			1
Pentatomidae	7		1
Neuroptera	1		
Tricoptera	1		2
Diptera			
Chironomidae	2		2
Mycetophilidae	10		8
Tabanidae	1		
Coleoptera			
Carabidae			2
Coccinellidae	48		30
Elateridae	2		
Lampyridae	1		
Scarabaeidae			1
Cerambycidae	13		5
Chrysomelidae	4		
Curculionidae	1		
Hymenoptera			
Ichneumonidae	2		2
	94	9.1%	57 5

II. Those that visit the flowers systematically but carry pollen only accidentally.

	Pears		Apples	
Hempitera				
Capsidae	17		15	
Corimilaenidae	2			
Lepidoptera			1	
Diptera				
Bibionidae	3		13	
Stratiomyiidae	64		35	
Empididae	105		53	
Syrphidae	60		20	
Conopidae	4		4	
Muscidae	55		61	
Coleoptera				
Dermestidae	75		8	
Hymenoptera				
Formicidae	10		2	
Vespidae	14		2	
Total	409	39.9%	214	16.7%

B. Those that visit flowers and carry pollen systematically.

	Pear		Apple	
Hymenoptera				
Andrenidae	402		562	
Apidae	119		311	
	521	50.8%	873	76.3%

From this table we see that the only insects that are of any practical value to the orchardist in assisting in pollination are the Andrenidae and Apidae.

The proportion of the different classes can readily be seen from the table.

Table XIV.

Dates and families of insects collected together with weather reports for 1902.

Date	Order	Family	No.	Temp.	Sunshine	Rain	Wind
May 2			9	62.3°	25%	7-9 A.M. .09	W.15
	Diptera	Syrphidae	3				
		Syrphidae	3				
	Hymenoptera		6				
		Andrenidae	6			night	S.E.14
May 3			66	61.°	100%	.54	
	Hemiptera		2				
		Capsidae	1				
		Pentatomidae	1				
	Neuroptera		1				
	Diptera		3				
		Stratiomyiidae	1				
		Empididae	1				
		Syrphidae	1				
	Coleoptera		23				
		Coccinellidae	1				
		Dermestidae	22				
	Hymenoptera		38				
		Ichneumonidae	1				
		Formicidae	1				
		Vespidae	1				
		Andrenidae	33				
		Apidae	2				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
						Night	
May 4			44	62.3°	100%	.08	W.6
	Hemiptera		2				
		Pentatomidae	1				
		Corimelaenidae	1				
	Diptera		4				
		Mycetophilidae	2				
		Syrphidae	2				
	Coleoptera		2				
		Coccinellidae	1				
		Chrysomelidae	1				
	Hymenoptera		36				
		Formicidae	1				
		Vespidae	2				
		Andrenidae	24				
		Apidae	9				
May 5			78	58.1°	50%	0	N.5
	Hempitera		4				
		Capsidae	3				
		Pentatomidae	1				
	Diptera		19				
		Stratiomyiidae	6				
		Empididae	3				
		Syrphidae	7				
		Conopidae	1				
		Muscidae	2				

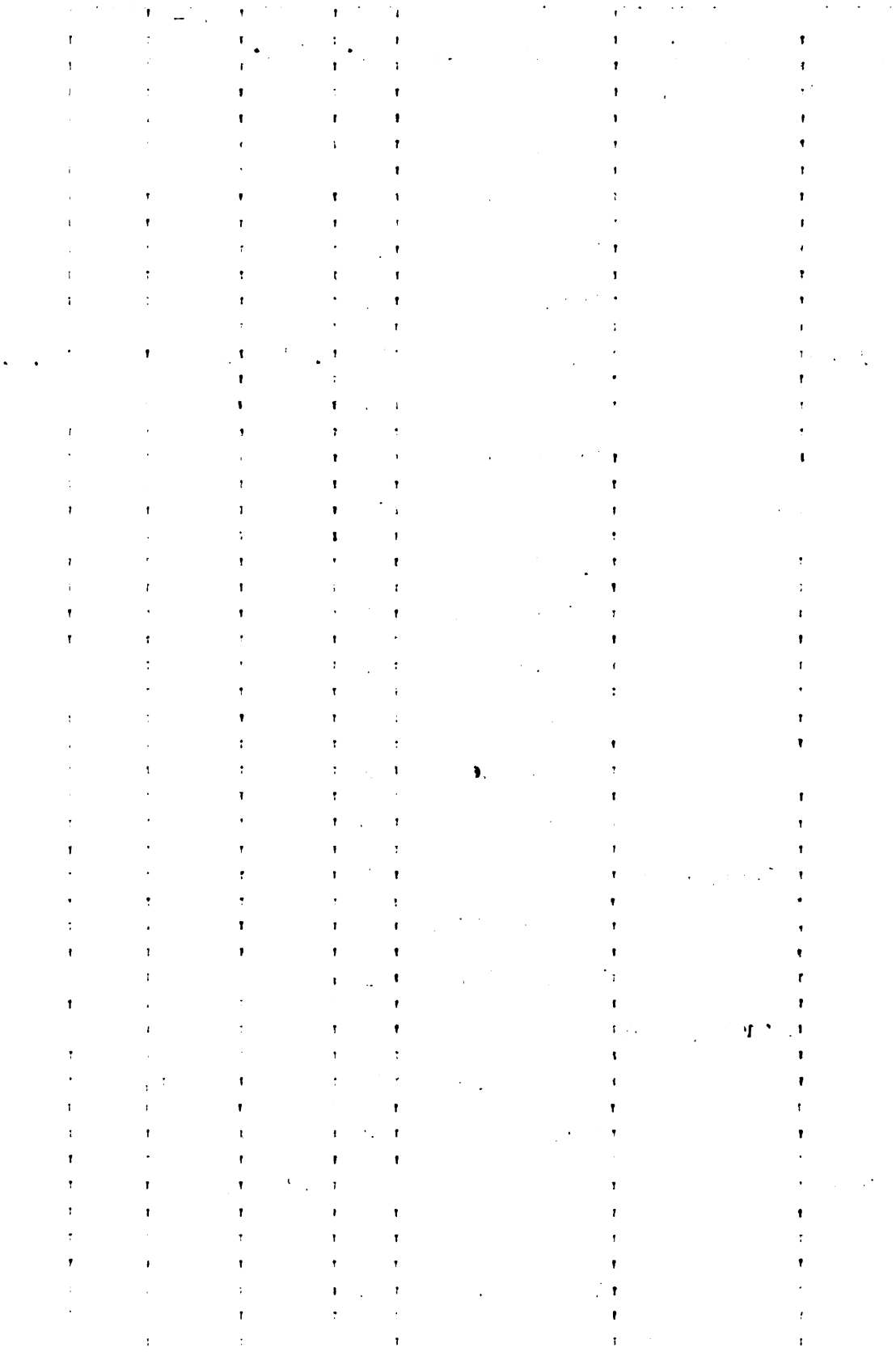
Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
	Coleoptera		4				
		Coccinellidae	2				
		Cerambycidae	2				
	Hymenoptera		51				
		Formicidae	2				
		Vespidae	3				
		Andrenidae	32				
		Apidae	12				
May 6			75	60.6°	15%	Day .65	S.9
	Hemiptera		6				
		Capsidae	4				
		Pentatomidae	2				
	Tricoptera		1				
	Diptera		16				
		Chironomidae	2				
		Stratiomyiidae	2				
		Empididae	1				
		Syrphidae	6				
		Muscidae	5				
	Coleoptera		7				
		Coccinellidae	7				
	Hymenoptera		46				
		Andrenidae	20				
		Apidae	26				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 7			58	53°		.80	N.W. 10
	Hemiptera		3				
		Capsidae	2				
		Lygaeidae	1				
	Diptera		10				
		Stratiomyiidae	5				
		Syrphidae	2				
		Muscidae	3				
	Coleoptera		14				
		Coccinellidae	13				
		Elateridae	1				
	Hymenoptera		31				
		Ichneumonidae	1				
		Vespidae	1				
		Andrenidae	7				
		Apidae	22				
May 8			273	63.3°	100%	0	S.W. 16
	Hemiptera		3				
		Capsidae	2				
		Pentatomidae	1				
	Tricoptera		1				
	Diptera		54				
		Mycetophilidae	1				
		Stratiomyiidae	14				
		Syrphidae	23				
		Conopidae	3				

Date	Order	Family	No.	Temp.	Sunshine	Rain	Wind
May 8		Muscidae	13				
	Coleoptera		8				
		Coccinellidae	8				
	Hymenoptera		207				
		Andrenidae	177				
		Apidae	30				
May 9			25	43.3°	90%	0	N.W.4
	Hemiptera		2				
		Capsidae	2				
	Diptera		8				
		Statiomyiidae	1				
		Empididae	1				
		Syrphidae	1				
		Muscidae	5				
	Coleoptera		2				
		Coccinellidae	2				
	Hymenoptera		13				
		Apidae	13				
May 10				36.3°	0	.35	N.E.6
May 11			96	48.3°	100%	0	N.4
	Hemiptera		1				
		Capsidae	1				
	Diptera		34				
		Stratiomyiidae	1				
		Empididae	3				
		Syrphidae	12				
		Muscidae	18				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 11	Coleoptera		1				
		Coccinellidae	1				
	Hymenoptera		60				
		Andrenidae	16				
		Apidae	44				
						Night	
May 12			278	59°	100%	.37	S.E.3
	Hemiptera		8				
		Capsidae	8				
	Tricoptera		1				
	Diptera		58				
		Chironomidae	1				
		Mycetophilidae	4				
		Bibionidae	3				
		Stratiomyiidae	5				
		Empididae	21				
		Syrphidae	7				
		Conopidae	2				
		Muscidae	15				
	Coleoptera		18				
		Carabidae	1				
		Coccinellidae	9				
		Dermestidae	5				
		Lampyridae	1				
		Scarabaeidae	1				
		Cerambycidae	1				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 12	Hymenoptera		193				
		Formicidae	3				
		Vespidae	2				
		Andrenidae	145				
		Apidae	43				
May 13			39	53°	12%	0	N.E.4
	Hemiptera		1				
		Acanthiidae	1				
	Diptera		29				
		Mycetophilidae	4				
		Bibionidae	2				
		Stratiomyiidae	3				
		Empididae	16				
		Syrphidae	1				
		Muscidae	3				
	Coleoptera		2				
		Coccinellidae	1				
		Dermestidae	1				
	Hymenoptera		6				
		Andrenidae	2				
		Apidae	4				
May 14			175	52°	100%	0	N4
	Hemiptera		2				
		Acanthiidae	2				



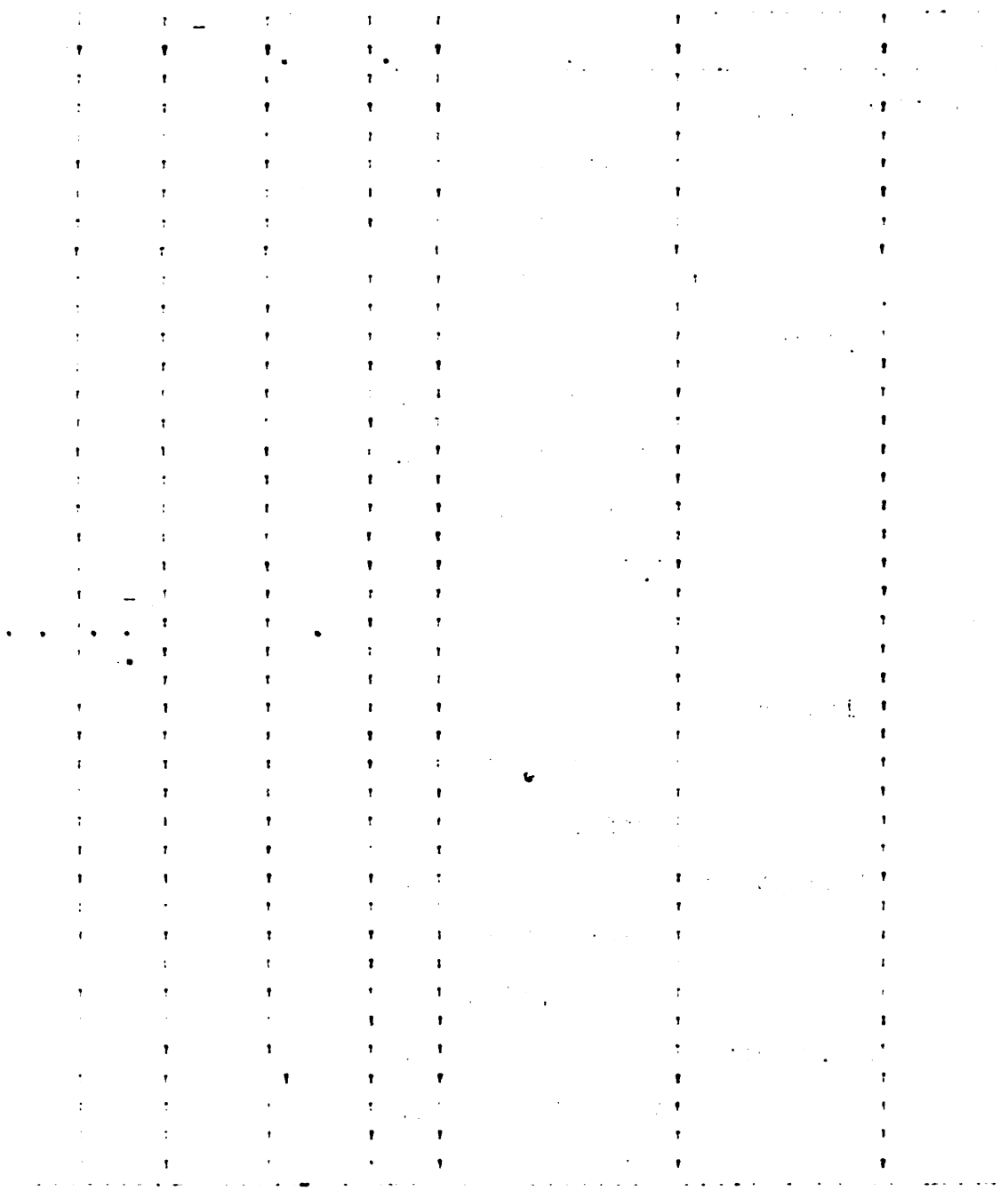
Date	Order	Family	No.	Temp	Sun-shine	Rain	Wind
May 14	Diptera		69				
		Mycetophilidae	3				
		Bibionidae	3				
		Stratiomyiidae	9				
		Empididae	36				
		Syrphidae	6				
		Muscidae	12				
	Coleoptera		13				
		Coccinellidae	8				
		Dermestidae	2				
		Cerambycidae	2				
		Chrysomelidae	1				
	Hymenoptera		91				
		Formicidae	1				
		Andrenidae	53				
		Apidae	37				
May 15			208	55.6°	100%	0	N.E.4
	Hemiptera		2				
		Capsidae	2				
	Diptera		54				
		Mycetophilidae	2				
		Bibionidae	2				
		Tabanidae	1				
		Stratiomyiidae	8				
		Empididae	18				
		Syrphidae	5				
		Conopidae	2				
		Muscidae	16				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 15	Coleoptera		13				
		Coccinellidae	4				
		Dermestidae	8				
		Cerambycidae	1				
	Hymenoptera		139				
		Formicidae	1				
		Vespidae	2				
		Andrenidae	86				
		Apidae	50				
May 16			216	58°	100%	0	S.2
	Hemiptera		3				
		Capsidae	1				
		Pentatomidae	2				
	Diptera		62				
		Mycetophilidae	1				
		Bibionidae	1				
		Stratiomyiidae	17				
		Empididae	18				
		Syrphidae	1				
		Muscidae	24				
	Coleoptera		26				
		Coccinellidae	21				
		Elateridae	1				
		Cerambycidae	3				
		Chrysomelidae	1				
	Hymenoptera		125				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 16							
		Formicidae	1				
		Vespidae	1				
		Andrenidae	73				
		Apidae	50				
May 17			215	66.3°	95%	0	S.W.4
	Hemiptera		4				
		Acanthiidae	1				
		Capsidae	2				
		Corimelaenidae	1				
	Diptera		50				
		Mycetophilidae	1				
		Bibionidae	4				
		Stratiomyiidae	15				
		Empididae	20				
		Syrphidae	1				
		Muscidae	9				
	Coleoptera		27				
		Coccinellidae	3				
		Dermestidae	20				
		Cerambycidae	2				
		Chrysomelidae	1				
		Curculionidae	1				
	Hymenoptera		134				
		Ichneumonidae	1				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 17							
		Formicidae	1				
		Andrenidae	78				
		Apidae	54				
						Day	
May 18				69°	0	.93	S.3
May 19			163	76.3°	100%	0	S.6
	Hemiptera		2				
		Capsidae	2				
	Diptera		15				
		Stratiomyiidae	5				
		Empididae	8				
		Syrphidae	2				
	Coleoptera		13				
		Carabidae	1				
		Coccinellidae	6				
		Dermestidae	2				
		Cerambycidae	4				
	Hymenoptera		133				
		Andrenidae	118				
		Apidae	15				
May 20			124	73.3		0	N.E.4
	Lepidoptera		1				
	Diptera		16				
		Stratiomyiidae	4				
		Empididae	7				
		Muscidae	5				

Date	Order	Family	No.	Temp.	Sun-shine	Rain	Wind
May 20	Coleoptera		13				
		Coccinellidae	4				
		Dermestidae	6				
		Cerambycidae	3				
	Hymenoptera		94				
		Formicidae	1				
		Vespidae	1				
		Andrenidae	78				
		Apidae	14				
May 21			30	70.3	80%	1-2 P.M. .13	S.W.9
	Diptera		8				
		Stratiomyiidae	3				
		Empididae	5				
	Coleoptera		3				
		Coccinellidae	2				
		Dermestidae	1				
	Hymenoptera		19				
		Andrenidae	17				
		Apidae	2				



Conclusions.

Hemiptera.--The number of specimens is so small that no conclusions can be drawn with reference to the effect of weather on this order.

Diptera.--The higher the temperature and the greater the percent of sunshine the more Diptera found. They do not fly during rain, but begin work soon after.

Coleoptera.--The higher the temperature the more specimens found. No relation between sunshine and specimens.

Hymenoptera.--The warmer the day the more specimens found. Sunshine same as temperature. Rainfall lessens number of specimens found. The velocity of wind apparently has no effect, but its temperature has.

Other things being equal the higher the temperature and more the sunshine the greater the number of insects found.

Table XV.

Number and Families of insects collected on pears in 1901 and 1902.

	1901		1902
Hemiptera 14%	64	2.6%	27
Acanthiidae			1
Capsidae	24		17
Pentatomidae			7
Corimelaenidae	40		2
Neuroptera			1
Tricoptera			1
Diptera 29%	125	30%	304
Tipulidae	1		
Culicidae	1		
Chironomidae	2		
Bibionidae	5		3
Tabanidae			1
Stratiomyiidae	27		64
Empididae	57		105
Syrphidae	2		60
Conopidae	9		4
Muscidae	30		55
Coleoptera 17%	78	14%	144
Pselaphidae	22		
Coccinellidae	35		48
Dermestidae	8		75

		1901		1902
Coleoptera (Cont.)				
Elateridae				2
Lampyridae		1		
Scarabaeidae		2		
Cerambycidae		1		13
Chrysomelidae		7		4
Bruchidae		1		
Curculionidae				1
Hymenoptera	40%	191	53.4%	547
Ichneumonidae				2
Braconidae		1		
Formicidae				10
Vespidae		5		14
Andrenidae	35%	164	39.2%	402
Apidae	4.5%	21	11.6%	119.
Total		458		1024

		1901		1902
Coleoptera (cont.)				
Coccinellidae		45		30
Dermestidae				8
Cleridae		1		
Scarabaeidae		1		1
Cerambycidae				5
Hymenoptera	61%	361	76.9%	879
Ichneumonidae				2
Formicidae		8		2
Vespidae		2		2
Andrenidae	46%	272	49.1%	562
Apidae	13%	79	27.2%	311
Total		592		1144

The proportionate number of insects collected in 1901 and 1902 on both fruits can readily be seen from the two preceeding tables.

General Conclusions.

The Hymenoptera are the most important insects in effecting cross-pollination of pears and apples.

The Hemiptera, Diptera and Coleoptera are found quite commonly on the two fruits but their work is insignificant compared with that done by the Hymenoptera.

The Apidae and Andrenidae, are the only two families of Hymenoptera that visit flowers and carry pollen systematically and hence the only ones of practical importance in this work.

In general about the same insects work on the two fruits.

The Apidae work more freely on apples than on pears.

The Diptera are found more abundantly on pears than on apples.

Insects are very sensitive to changes of temperature and rain.

General Observations.

Andrenidae were more abundant in proportion to the Apidae in 1901 than 1902.

Although the specimens captured do not show it we believe the Apidae and Andrenidae about equal in numbers on apples in 1902.

Andrenidae were more abundant than Apidae on the pears both years.

Bombus were much more abundant in 1902 than 1901.

Corimelaenidae were much more abundant in 1901 than in 1902.

Dermestidae were more abundant in 1902 than in 1901.

We believe the Andrenidae are much more abundant than is commonly supposed.

From the number of insects observed we would say that, in this locality, there are enough insects to pollinate a sufficient number of the flowers to insure a crop.

Bibliography.

In looking up the literature on this subject we find that very little work has been done directly on the topic in hand; considerable has been accomplished, however, showing the necessity of cross-pollination.

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