TWENTY-FOURTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1893.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

TORONTO:
WARWICK BROS. & RUTTER, PRINTERS, 68 AND 70 FRONT ST. WEST
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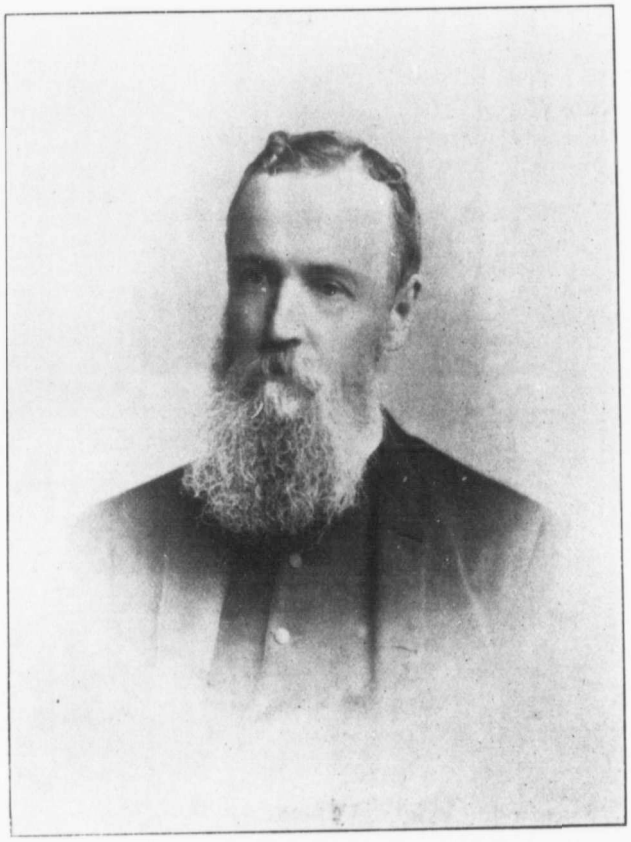

REV. C. J. S. BETHUNE, M.A., D. C. L., F. R. S. C.

PRESIDENT of the Entomological Society of Ontario, 1871-5; 1890-2.
VICE-PRESIDENT 1876-7, 1879, 1881, 1886-7.
EDITOR of *The Canadian Entomologist*, 1868-1873, 1886-1894.

TWENTY-FOURTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to present herewith the twenty-fourth annual report of the Entomological Society of Ontario, which shows that good progress has been made in every line of work that it has undertaken. While I should not omit to refer to the maintenance of the Society's world-wide reputation as one of the leaders in Economic Entomology, it is worthy of mention that the local interest and membership of the Society shows a decided increase, proving that the methods adopted by the Society for the attainment of its ends are well suited to the purpose.

I have the honor to be, Sir,
Your obedient servant,

W. E. SAUNDERS,
Secretary.

OFFICERS FOR 1894.

President	W. H. HARRINGTON	Ottawa
Vice-President	J. W. DEARNESS	London.
Secretary	W. E. SAUNDERS	do
Treasurer	J. A. BALKWILL	do

Directors :

Division No. 1	JAMES FLETCHER	Ottawa.
" 2	REV. C. J. S BETHUNE	Port Hope
" 3	GAMBLE GEDDES	Toronto.
" 4	A. H. KILMAN	Ridgeway.
" 5	R. W. Rennie	London.

Librarian and Curator	J. A. MOFFAT	do
Auditors	J. H. BOWMAN	do
	J. M. DENTON	do
Editor of the "Canadian Entomologist"	REV. C. J. S. BETHUNE	Port Hope.
Editing Committee	J. FLETCHER	Ottawa
	H. H. LYMAN	Montreal.
	Rev. T. W FYLES	South Quebec.
	J. M. DENTON	London.
	J. H. BOWMAN	do
Delegate to the Royal Society	Rev. T. W. FYLES	South Quebec.

ANNUAL MEETING OF THE SOCIETY.

The thirty-first annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, October, 11th and 12th, 1893. In the absence of the President, the chair was occupied by Mr. J. M. DENTON, the Vice-President.

The meeting was called to order at 3 p m., when the following members were present: Rev. T. W. Fyles, South Quebec; J. Fletcher, Ottawa; Rev. C. J. S. Bethune, Port Hope; J. M. Denton, R. Elliott, J. A. Balkwill, H. Stevenson, J. A. Moffat, R. W. Rennie, G. F. Sherwood, W. McClement, W. J. Stevenson, W. E. Saunders, London, and others. Letters of regret for their inability to attend were read from Mr. W. Hague Harrington, Ottawa, the President; Mr. H. H. Lyman, Montreal; Mr. A. H. Kilman, Ridgeway.

REPORT OF THE TREASURER.

The Treasurer, Mr. J. A. Balkwill, presented the annual statement of the finances of the Society, as follows:

RECEIPTS, 1892-93.

Balance on hand for last year	$ 319 13
Members' fees	297 51
Sales of *Entomologist*	66 07
" pins, cork, etc	55 78
Advertisments	12 03
Government grant	1,000 00
Interest	10 64
	$1,761 16

EXPENDITURE, 1892-93.

Printing	$ 542 05
Report and meeting expenses	231 60
Library account	31 35
Purchase of collection	50 00
Expense account (postage, etc.)	63 04
Rent and fuel	40 00
Insurance	35 00
Salaries	300 00
Cork, pins, etc	10 58
Balance	457 54
	$1,761 16

We have examined the books of the Entomological Society of Ontario, compared them with vouchers and find them correct and affirm that the above statement is in accordance therewith.

(Signed) JAS. H. BOWMAN, W. E. SAUNDERS, } Auditors.

London, Ontario,
October 10th, 1893.

The Treasurer explained the various items of receipts and expenditure, and explained that the balance on hand, $457.54, though apparently larger than usual, would all be absorbed before the end of the year by the printing and other accounts; the item of $50 for the "purchase of collection" was the last instalment of the amount due to Mr. Moffat, and that this sum would be available for the benefit of the Library next year. He urged very strongly that some date should be fixed upon for the close of the Society's financial year, and that it should not depend upon the time of the annual meeting, which varied very considerably from year to year. After the Report of the Treasurer had been adopted, and a vote of thanks for his services unanimously carried, it was resolved, after some discussion, on motion of Mr. Saunders, seconded by Dr. Bethune, that the financial year of the Society should in future be closed on the 31st of August, except when the annual meeting was held earlier than that date.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows:

I beg leave to submit the following report for the year ending 31st of August, 1893: Seventy volumes have been added to the Library during the past year.

Several bound volumes were received from Governments and public institutions, the most important of which are: The Report of the New York State Museum; The Report of the Ontario Game and Fish Commission (Illustrated); The Mammals of Minnesota (Illustrated); The Annual Report of the Smithsonian Institution; The 10th Volume, Proceedings and Transactions of the Royal Society of Canada; The 17th Report of the Geology and Natural History of Indiana; The Hawks and Owls of the United States (beautifully illustrated).

Those added by purchase are: Gray's Manual of Botany; Scudder's Guide to Butterflies; The Life of a Butterfly, S. H. Scudder.

The whole number now on the register is 1,284. The number of volumes issued to local members was 46.

Several interesting additions were made to the native collection of Lepidoptera. A few attractive things were added to the exotics.

A box of beetles was kindly sent to the Society by Mr. Trevor C. D. Kincaid, Olympia, Washington State, which have been placed in a drawer by themselves, and the donor's name attached.

A small but interesting and valuable collection of Rocky Mountain Butterflies has been loaned to the Society by Mr. T. B. Parkinson, one of our local members. They were taken by Dr. W. Hayden, Canmore, and presented by him to Mr. Parkinson.

Through the kind consideration of Prof. C. H. Fernald, Amherst, Mass., the Society has been put in possession of a complete life series of the Gypsy Moth, *Ocneria dispar*, Linn.

The valuable English collection had suffered severely from insect pests. By a liberal use of white crystallized napthaline, the work of destruction was at once arrested, and is now completely overcome. I find this material to be a clean, safe and certain preventive, and even a complete exterminator of insect pests.

Respectfully submitted,

J. Alston Moffat.

Librarian and Curator.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

By W. Hague Harrington, Delegate.

I have the honor, as duly appointed delegate from the Entomological Society of Ontario, to submit a brief report on its operations during the past year. It is very satisfactory to state that, after a highly useful existence of thirty years, the Society flourishes with unimpaired vigor, and that its members continue with unabated zeal, the investigation of the insect fauna of our vast territories to the gain both of science and of the agricultural industries of the country.

The *Canadian Entomologist*, the official organ of the Society, completed, during 1892, its twenty-fourth volume, and the demand for admittance to its pages was so great that they were increased from the standard number of 240 to no less than 323. There were fifty-two contributors to the volume; among them many of the most prominent entomologists of Canada and the United States.

In the systematic papers were published descriptions of five new genera, and ninety-six new species of insects; chiefly Diptera, Lepidoptera and Hymenoptera. Of more than ordinary interest were some of the articles on collecting, breeding, geographical distribution, classification, etc.

The following were some of the more important papers published during the year:

Can Insects Survive Freezing? Mr. H. H. Lyman.

Entomology for Beginners—Three papers, Mr. J. Fletcher, Mr. H. F. Wickham.

Descriptive papers on N. A. Diptera, Mr. C. Tyler Townsend.

Notes on Coleoptera, Dr. John Hamilton.

Orthoptera of Indiana, Mr. W. S. Blatchley.

Miscellaneous Notes on Butterflies, Larvæ, etc., Mr. W. H. Edwards.

Getting Butterfly Eggs, Mr. W. G. Wright.

Classification of North American Spiders, Mr. Nathan Banks.

New North American Homoptera, Mr. E. P. Van Duzee.

New North American Microlepidoptera, Prof. Fernald.

Canadian Galls and their Occupants, Mr. Wm. Brodie.

Four Insect Monstrosities, Mr. H. F. Wickham.

Insects attracted by Fragrance or Brilliancy of Flowers for purpose of Cross-Fertilization, Dr. R. E. Kunze.

The Inhabitants of a Fungus, and Life History of Xenos, Mr. H. G. Hubbard.

A full report was also published of the meeting of the Entomological Club of the A.A.A.S., including the very valuable address of the President, Mr. E. A. Schwarz, which dealt very thoroughly with the work hitherto accomplished in North American coleopterology. When to the foregoing contents are added the book notices of current publications on economic and systematic entomology, correspondence and records of varieties and rare species, obituary notices, etc., the result is a volume of much value and interest to all who are interested in the study of insect life.

The society also furnished to the Ontario Department of Agriculture the usual annual report (No. 23) which consisted of 88 pages, with numerous illustrations. In addition to a full report of the proceedings at the annual meeting of the society, it contained some valuable special papers, of which may be mentioned the following:

A Visit to the Canadian Haunts of the late Philip Gosse, Rev. T. W. Fyles.

A Trip to Mount Washington, Mr. H. H. Lyman.

Notes on the Rarer Butterflies of the Province of Quebec, Rev. T. W. Fyles.

On the Power of Insects to Resist the Action of Frost, Mr. J. A. Moffat.

Some Injurious Microlepidoptera, Mr. J. A. Moffat.

The Hornfly, Mr. James Fletcher

Clothes Moths, Mr. James Fletcher.

The Songs of Our Grasshoppers and Crickets, Prof. S. H Scudder.

The thirteenth annual meeting of the Society was held in its rooms in London, on Wednesday, August 21st, and Thursday, September 1st. The President, the Rev. Dr. Bethune, F.R.S.C., delivered a very valuable address, in the course of which he discussed those insects which had been reported as most numerous and destructive during the year. Interesting papers were also read by several members, and reports were received from the Geological, Botanical, Ornithological and Microscopical Sections, and also from the Montreal Branch, which for many years has regularly brought together for mutual instruction the students of entomology in that city and vicinity.

The Society was honored during the year in the election of Rev. Dr. Bethune to the distinguished position of President of the Entomological Club of A. A. A. S., and Vice-President of the Association of Economic Entomologists.

TWENTIETH ANNUAL REPORT OF THE MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The council beg to submit the following report of the work of the Branch during the session of 1892-93.

Eight monthly meetings have been held and the following papers have been read:

Notes on Zaraea Americana, Rev. T. W. Fyles.

A Trip to Mt. Washington, H. H. Lyman.

Notes on the Lepidoptera of Cap a L'aigle P. Q, A. F. Winn.

Preparatory Stages of Anisota Pellucida, H. H. Lyman.

Life History of Nemeophila Scudderii, H. H. Lyman.

Notes on Taxonus Dubitans and T. Nigrosoma, J. G. Jack.

Notes on Collecting Sesiidæ in the London (England) District, L. Gibb.

List of Lepidoptera collected by Dr. Bell in the Country North of Lake Huron, H. H. Lyman.

We have, since our last annual meeting, lost another of our members who was an enthusiastic worker in the study of insects, by the death of Mr. J. W. Cushing.

Your council regret that the attendance at the meetings during the past season has not been as good as in former years, and would urge on the members the necessity of doing all in their power to increase the interest of the meetings and to endeavor to add to our roll as many new names as possible.

The report of the Treasurer shows a balance at our credit of $19.24.

Submitted on behalf of the council.

(Signed) H. H. Lyman,
President.

The following officers were elected for the ensuing year:

President, H H. Lyman; Vice-President, L. Gibb; Sec.-Tres., A. F. Winn; Council: J. F. Hausen, H. B. Cushing.

Regret was expressed that no member had been able to represent the Society at the annual meeting of the Association of Economic Entomologists held at Madison, Wisconsin, in August. (Through the kindness of Mr. Howard, a full account of the proceedings has been received and will be found in subsequent pages of this report.) At the meeting of the Entomological Club of the American Association for the Advancement of Science, held at the same place, Mr. Lyman, of Montreal, one of our members, was present, and read a paper on *Hepialus Thule*.

A paper entitled "Notes and Queries," by the Rev. Dr. Holland, of Pittsburg, was read by Dr. Bethune; the writer referred especially to the occurence of *Erebus odora*, *Papilio cresphontes* and *Philenor* and other insects. In the discussion that followed, it was stated by Messrs. Moffat and Saunders that they found *P. cresphontes* in abundance about London, and also its larvæ. Dr. Bethune reported having taken it at Roach's Point, Lake Simcoe, on the 28th of August last. He mentioned also the capture at Port Hope, on the 15th of October, of a male specimen of *Colias Eurytheme*, the first that he had seen in that neighborhood. *Papilio philenor* had formerly been taken near Toronto and Hamilton, but not of late years; its larvæ had been found at Ridgeway feeding upon Wild Ginger, *Asarum Canadense*.

Mr. Fletcher exhibited an illustration of a gall on *Negundo aceroides* made by a moth, and described its peculiarities; also specimens of *Silpha bituberosa* from Saskatoon. Some larvæ were recently sent him from there, which were feeding upon *Monolepis chenopodioides*, an abundant plant in the prairie region; from these he bred the beetle, *S uberosa*.

Mr. Elliott exhibited some galls found on Hackberry, *Celtis occidentalis*, which are probably the work of a Psylla. This elicited a discussion on the very remarkable distribution of the tree in Canada, which occurs in small numbers in isolated localities, as for instance at Como, P.Q., Ottawa, Bowmanville and the neighborhood of London.

Mr. H. Stevenson showed an interesting prickly gall from the wild blackberry, *Rubus villosus*, which was probably produced by a *Rhodites*.

The Rev. T. W. Fyles read a paper on "Notes of the year 1893." In the discussion that followed, Mr. Fletcher stated that he had found *Telea polyhemus* on Cornus; he had also found *Catastega aceriella* very abundant on maple trees at Ottawa. *Nisoniades Horatius* was this year quite common on Columbine (*Aquilegia*); of *Argynnius triclaris* he had taken seven specimens near Ottawa, a butterfly that hitherto has only been known to occur in the barren lands of the Peace River.

Mr. McGill exhibited his patent Composition Tree-protector, which is very simple in construction, easy to apply and an excellent defence against canker-worms, and also useful as an attractive hiding-place for codling worms and other larvæ.

The meeting adjourned at 5.30 p.m.

EVENING SESSION.

In the evening the Society held a public meeting in its room in Victoria Hall at 8 o'clock, which was largely attended by members and other friends from London and the vicinity. In addition to those already mentioned as present in the afternoon, the following were noticed: Rev. Dr. Andras, Mr. J. Foote, Dr. Woolverton, Dr. Wilson and others. The chair was taken by Mr. Denton, the Vice-President, who apologized for the unavoidable absence of Mr. Harrington, the President of the Society.

REPORT OF THE COUNCIL.

The following report was then read by the Secretary and adopted:

The Council of the Entomological Society of Ontario beg to present the following report of the proceedings of the Society during the past year. The membership of the Society shews a considerable increase over that of last year, especially in the addition of a large number from the Province of Ontario. Much interest has continued to be taken in the various departments of the Society and much satisfactory work has been accomplished.

The Twenty-third Annual Report on practical and general Entomology was presented to the Minister of Agriculture in November last, and was printed and distributed early in January. It consisted of eighty-eight pages and was illustrated with forty-five wood cuts. The report contained, among other interesting matter, a remarkable paper by Mr. S. H. Scudder on "The Songs of our Grasshopers and Crickets"; a long and interesting account by Rev. T. W. Fyles of "A visit to the Canadian Haunts of the late P. H. Gosse," which was especially noticed by the Toronto *Globe* of April 6th, and other newspapers; also a timely article by Mr. Fletcher on the Horn fly.

The *Canadian Entomologist* has been regularly issued at the beginning of each month and completed its twenty-fourth volume in December last. It consisted of 323 pages, being the largest number yet issued. Ten numbers of the twenty-fifth volume have been published, each averaging twenty-six pages. The Council take this opportunity of thanking their numerous contributors, among whom are included all the leading Entomologists of North America, for their valued assistance, which has enabled them to maintain the position held for so many years of being one of the leading Entomological journals of the world, as well as the best in America. The library has been increased by the addition of seventy valuable works, making the whole number of volumes in the rooms of the Society nearly thirteen hundred.

A considerable number of rare specimens have been added to the collections, and the Council have pleasure in again acknowledging the careful and painstaking services of the Curator, Mr. J. Alston Moffat, who has at all times shown his readiness to assist the members, and particularly beginners, in the identification of specimens and the prosecution of their studies.

Interest in the various sections engaged in the study of the allied sciences of Botany, Microscopy, Geology and Ornithology, has not flagged, a number of new members having been added to the Society through this channel, and good work accomplished in each branch. Reports from the sections are submitted herewith and will be found to give an outline of the work undertaken.

The annual report of the Treasurer shows a present balance of $457.54, which amount will be scarcely sufficient to meet the expenses of the Society during the winter session, but by careful economy it is hoped that the expenditure will not exceed the balance in hand to any great extent.

The Society was represented at the meeting of the Royal Society of Canada, which was held at Ottawa in May last, by your President, Mr. Harrington, whose report is presented herewith.

All of which is respectfully submitted,

(Signed) W. E. Saunders, Secretary.

In the absence of the President, Mr. James Fletcher, Dominion Entomologist, gave a highly interesting address upon the chief insect attacks of the year, which was listened to with great attention.

INJURIOUS INSECTS OF THE YEAR.

By James Fletcher, Ottawa.

I regret that the President has been prevented from being here to day to deliver his annual address. I am sure that some very important business in connection with his office has caused his absence, as I know that he fully intended to be present. I am glad to be able to report that no serious new pests of the farm have made their appearance during the past season, and with the exception of the Horn-fly and three species of Locusts, generally known under the collective name of "Grasshoppers," none of the old enemies have shown themselves in unusual numbers. Of household pests the common Clothes Moth (*Tineola biselliella*, Hum) was for some reason extremely abundant and injurious in many parts of the Province. Two of the most interesting attacks which have been brought under my notice are : (1.) The gall-making larva of a small moth which passes its larval life in the young twigs of the ash leaved maple, *Negundo aceroides* Several specimens of the swollen twigs containing caterpillars were sent to me from Mr. W. G. Fonseca, of Winnipeg, who has observed the insect for some years. I was able to breed the moths this year as well as two distinct parasites. None of these have yet been named. About half the larvæ were found to be parasitised. (2.) The other attack alluded to is of the larvæ of one of the Carrion beetles, *Silpha bituberosa*, Lec., upon squashes and chenopodiaceous plants at Saskatoon in the North-West Territories. In England a closely allied species, *S. opaca*, is sometimes a serious enemy of the beet-root. It is this fact which gives the present record importance, from the possibility of *S. bituberosa* developing a taste for cultivated plants as the country becomes more settled. The larvæ are nocturnal in their habits, black, half an inch in length, shaped like wood-lice and are very active. I received the larvæ when nearly full-grown and soon afterwards they buried themselves in the earth. About two weeks later the beetles

emerged. At first I took them for the European species, which, however, it is said, also occurs in this country, but Dr. George H. Horn has kindly identified them for me as *S. bituberosa*, a native species of the North-West Territories. It is probable that the usual habit of this insect as well as of *S. opaca* is to feed upon carrion ; but the fact that they occasionally develop a taste for vegetation makes it necessary to be on guard against them.

Cut-worms were as usual complained of in various districts, the species most commonly sent in being *Carneades messoria*, Harr. (Fig. 1) in onion-beds, *C. ochrogaster*, Gn., omnivorous and *Noctua fennica*, Tausch, chiefly in clover and pea fields. The easy remedy of wrapping a piece of paper around the stems of freshly planted tomatoes and cabbages is becoming very popular amongst those who have tried it. In my own experience I have found it one of the most satisfactory remedies. It is done at the time of planting, is very easy and takes hardly any time. The easiest way is to have a bundle of paper all cut to the right size, about three inches square. Thread these close to one corner on a loop of string and tie this to the basket or box in which the young plants are carried to the field. Before planting a cabbage, pull off one sheet of the paper and lay it on the palm of the left hand, then taking the young plant in the right hand place the stem across the paper and close the left hand, this will leave a loose collar of paper around the stem between the top and the root. When planting leave about two inches of the paper above the ground.

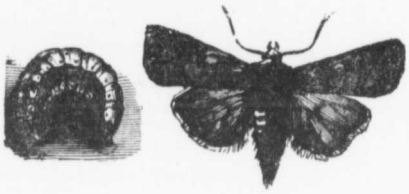

Fig. 1.

The *Turnip Flea* On the whole, there have been fewer complaints of the flea beetle (Fig. 2) this season than for many years. The best remedy is to dust the young plants as soon as they appear above the ground with a mixture of land plaster and Paris Green in the proportion of 25 to one. The land plaster acts as a stimulant to the young plants and soon pushes them past the stage when they are liable to injury from the beetles. The mixture must be perfectly dry. Leaf-hoppers of various kinds have been abundant in some localities and upon various crops. *Erythroneura vitis*, Harr., the Leaf-hopper of the Vine sometimes called "The Thrip," has been successfully treated upon the Virginia creeper and grape by spraying with Kerosene Emulsion. Another species, *Empoa fabæ*, Harr., has been abundant and injurious upon the English Horse-beans, which are now being extensively grown by farmers for mixing with Indian corn and the seeds of sunflowers in the preparation of ensilage, according to the new Robertson combination. The horse-bean seems to be very susceptible to injury from insects. The *Empoa* above named causes the leaves to turn black and dry up. A large flea-beetle (*Systena frontalis*, Fab.) also injured this plant, among several others, by eating the soft tissues of the upper surface of the leaves. The common Red-legged Locust was even more injurious in the same way, and in the North-West Territories, the large and beautiful Western Blister-beetle (*Cantharis Nuttalli*, Say) entirely defoliated patches of these beans. The sunflower, grown for the seeds, was not without its enemies either—early in the season Cut-worms attacked the young seedlings and later the stems of many plants were much weakened by the pith being entirely consumed by the larvæ of the beautiful Trypetid fly (*Straussia longipennis Wied*). The female is furnished with a hard ovipositor by means of which she inserts her eggs into the stems while soft and the young larvæ live in the pith. They pass the winter as pupæ in the ground and the perfect flies appear in June, when they may be found on Sunflowers and the Jerusalem Artichoke. The fly is deep honey yellow with bright green eyes and has the wings prettily mottled with brown. The season in the Ottawa district has been a particularly wet one and as a consequenc some of the usually abundant injurious insects have been conspicious by their absence. Of

Fig. 2.

these mention may be made of the Colorado Potato beetle which has been kept in check with less trouble than usual. Of course the only practical remedy is Paris Green, which meets all requirements cheaply and effectively. Several instances have been brought under my notice of the ravages of the Gray Blister-beetle (*Macrobasis unicolor*, Kirby) upon Potatoes and Horse-beans. This beetle is most frequently found in the perfect state upon the Fall Meadow Rue (*Thalictrum Cornuti*) but also occurs on other plants. In the larval condition it lives as a parasite upon the eggs of Locusts. A closely allied species with similar habits was sent in from two or three localities as a pest upon mangels, vegetables and garden Asters, of which last it destroyed the flowers.

Red Spiders have been abundant and injurious to many plants in those parts of Ontario where dry weather has prevailed, currant bushes and beans were particularly attacked. Spraying with a weak Kerosene Emulsion has been found to be one of the best remedies. On the Experimental Farm a small species of *Scymnus*, one of the Lady-bird beetles, was found to be very useful in thinning their numbers.

A stalk borer (*Hydræcia cataphracta*, Grt.) was locally troublesome in tomato fields and also occurred in several herbaceous plants, as holyhocks, sunflowers and lilies.

The root maggots of the cabbage and onion still remain troublesome pests of the market gardener. When attacking cabbages, the best results have been obtained by pouring hellebore-tea around the roots, and with onions and radishes some experiments with common salt were apparently attended with the greatest measure of success this season. These experiments will be repeated again next year.

Two of the true bugs *Lygus pratensis*, L., the Tarnished Plant-bug, (Fig. 3) and *Pœcilocapsus lineatus*, Fab. both common species, have been very abundant and injurious in some localities this year. Perhaps the most practical remedy for these is beating the infested plants over a beating net or pan containing some water, with a little coal oil on the surface. This is best done early in the morning when the insects are not so active as later in the day.

Several kinds of plant lice have been abundant in gardens. Species upon turnips, carrots, cabbages and celery having been sent in. The best remedy for these insects, where it is practicable, is to spray the plants with a kerosene emulsion, as early as possible in the season, before they have multiplied.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Of insects injurious to forest trees mention may be made of two small caterpillars which have been attacking the maples in some parts of Ontario and Quebec. The first of these *Incurvaria acerifoliella*, Hew. is a case-maker, which cuts out round disks of the maple leaf and forms a flat case, inside which it lives. In the autumn it falls to the ground and passes the winter inside its case as a pupa. The tiny steel-blue moths, with orange collars, emerge the following spring. The other is the species which has been mentioned by Mr. Fyles, possibly *Catastega aceriella*, Clem. The larva forms a tent between the two surfaces of the leaf and lives inside a tube made out of its own frass. This tube starts close to the petiole and gradually enlarges as the larva grows, until it

reaches about two inches in length. The tents were so abundant this autumn in some places that the maple trees about Knowlton and other places round Brome Lake in the Eastern Townships were much disfigured. It is also very abundant at Ottawa. I have never seen the moth yet, but have several of the larvæ and pupæ in my breeding cages, from which I hope to get the moths next spring.

Of fruit insects, some of the well known pests have called for attention, as the Eye-spotted Bud moth (*Tmetocera ocellana*, Schif.), on the apple and plum, the Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché), the Beautiful Wood Nymph (*Eudryas grata*, Fab.). Fig. 4 represents the moth and Fig. 5 the caterpillar. The Codling Moth (*Carpocapsa pomonella*, L) and the Plum Curculio (*Conotrachelus nenuphar*, Hbst.). For these the well-known remedies have been recommended.

Injuries of less frequent occurrence have been reported by the following: Click beetles, which have injured the flowers of apples at Ottawa and of pears in Nova Scotia. The Shot-borer or Pin-borer (Fig. 6) (*Xyleborus dispar*, Fab.) has increased and is doing much injury to the apple-growing districts of Nova Scotia. Washing the trees in June with a soap or lime wash, to which a little Paris green has been added, will probably be found to be the best remedy. In the Niagara district I found last spring that the peach trees were much infested by the Peach-bark beetle (*Phlœotribus liminaris*, Harr.). This is a very small Scolytid and can be easily recognized by its laminate antennæ.

A new pest of the apple in Canada has been sent to me by Mr. R. Z. Rogers, of Grafton, Ont., and Mr. F. J. Watson, of Okanagan Mission, B.C., namely, the Otiorhynchid beetle *Anametis grisea*, Horn. The beetle gnaws the bark from the twigs and also eats out the buds. I have not yet worked out its life-history.

As mentioned above, the insects which have attracted most attention during the season of 1893 by their injuries are the Horn-fly (*Hæmatobia serrata*, Rob.-Desv.) shown much enlarged at Fig. 7, and the three common locusts, which occur all through

Fig. 6.

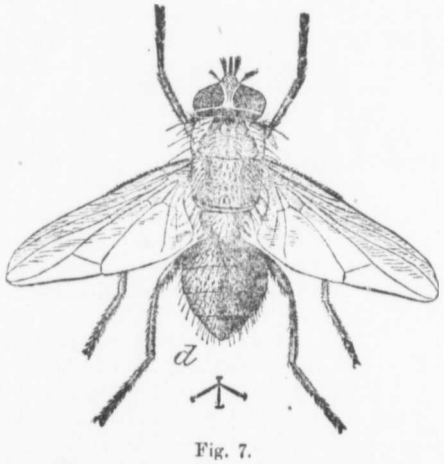

Fig. 7.

Ontario. As was anticipated, the Horn-fly, since first noticed last year, has spread far and wide over the Province, and although there has been a great hue and cry amongst farmers, very few of them have systematically treated their cattle to protect them from the attacks of their tormentors. The loss consequently has been very great, owing to the falling off in the quantity of milk produced at the season of the year when it should have been most plentiful. It is not probable that the Horn-fly will continue to be as serious a pest after a year or two as it is at present in Ontario, nevertheless it is an important matter that dairymen and farmers should adopt some one of the simple and effective remedies which have been discovered and practise them regularly if they wish to keep their stock in a state of comfort and prevent an unnecessary shortage in their bank accounts. In the first place

it is necessary to remember that the Horn-fly does not in any case breed (that is, pass its preliminary stages) on or in the cattle; but the eggs are laid on freshly dropped cow dung; the young maggots hatch within 24 hours and live until full grown in the moist excrement; this takes about a week; they then burrow down a short distance into the ground and assume the pupal form, from which, in about another week, in summer, the perfect flies issue. The last brood of autumn passes the winter beneath the ground within the puparia. The flies are extremely active and swarm on cattle, biting them and giving them much annoyance from the irritation of their bites. The name Horn fly is applied to this insect from its habit of clustering upon the horns of cattle. Here they are out of the reach of the animal's tail and are not easily dislodged. They do no injury whatever to the horns.

Remedies. The remedies are simple, but require constant attention to be effective. Almost any greasy substance rubbed over the parts of the animal usually attacked will prevent the flies from biting for two or three days. For this purpose "tanners' oil" or any other cheap fish oil is satisfactory, and if a small quantity of carbolised oil, which can be prepared in a short time by any druggist, be added, the effect will be more lasting and the application will have a healing effect upon any sore which may have been made by the animal rubbing or licking itself. An easily applied remedy, which has been found effective by most who have tried it, is the kerosene emulsion, which is practically a mixture of soapsuds and coal oil in the proportion of two of coal oil to one of soapsuds. To make the emulsion, boil half a pound of any common hard soap in one gallon of water; when all is dissolved, and while boiling hot, pour it into a large tub containing two gallons of coal oil, then churn this well with a syringe or force-pump for five minutes, when the mixture will be smooth like cream. This emulsion cools into a jelly-like mass, and may be kept for any length of time if placed in a cool cellar. When required for use, it may be diluted with cold water to the strength required. One part of the emulsion to nine of water works well. It is easily applied to the animals by means of a force pump and spray nozzle. While the flies are bad, it should be applied every other day for a fortnight; after that the odour of the accumulated coal oil will keep them off for a longer time. There certainly is a good deal of work about this application which farmers may object to, but so long as the flies are as numerous as at present, it will be necessary to take these extra precautions if they wish to protect their cattle and their own interests. It is well to mention, however, that in all the districts in the United States where three or four years ago this insect was extremely abundant, it has decreased greatly in numbers, and there is every reason to anticipate that this will be the case here too.

Throughout all the western portions of the Province a large amount of loss has been caused by locusts. All the specimens sent to me have belonged to three different species, which are always common, viz., the Red-legged Locust (*Melanoplus femur-rubrum*, DeG.) Fig. 8. The Lesser Migratory Locust (*Melanoplus atlanis*, Riley) and the Two-striped Locust (*Melanoplus bivittatus*, Say.). The Red-legged Locust has a very wide range and is common in all parts of the country. It attacks all kinds of vegetation, and has a particularly bad habit, which has been much noticed this year, of biting off the heads of oats just before they ripen. The Lesser Migratory Locust resembles the last named very much. It is, as a rule, rather larger and brighter in colour. It has longer wings and can always be separated from it by the sharply-pointed sternum or breast-bone, that of *femur-rubrum* being spatulate or enlarged at the apex. This species is migratory in its habits, like the Rocky Mountain Locust, and frequently is the cause of great injuries to crops, not only in the North-west, but in Ontario and New England; in fact, Prof. Bruner credits it with being the species which most frequently does the locust injury in the New England States.

b

Fig. 8.

The Two-striped Locust is a large, heavy-bodied and voracious species, which destroys a great amount of vegetation. It generally frequents rank growing plants in low ground, but as often occurs in gardens, where it is very troublesome.

Locusts are, as a rule, kept within due limits by their many enemies, but occasionally they appear in large numbers and increase so much as to cause locust plagues or "grasshopper years." This is generally in dry summers, when they get the conditions which are most advantageous for their development, but which are adverse to the free growth of vegetation. In such years it is necessary to have recourse to artificial means to protect crops. The most successful of these have been the plowing under deeply of the eggs, which have been known to have been deposited in certain localities, before they have time to hatch, and the use of the tar-pan or "hopper-dozer," by means of which the insects are caught in large numbers and destroyed before they have developed their wings. These tar-pans are large, shallow pans, made of sheet iron after various patterns, but, as a rule, about twelve feet long by three wide, with the edge turned up slightly in front and the back about eighteen inches high. In the bottom of these pans a small quantity of tar or coal oil is placed and they are then drawn over the fields by horses. The grasshoppers spring in the air when the pan is drawn towards them and fall inside the pan, where they come in contact with the tar or oil, and even if they hop out again they are sure to die. In this way enormous quantities are destroyed every year in the Western States.

A vote of thanks to Mr. FLETCHER, for his valuable and highly interesting address, was moved by Rev. T. W. FYLES, who remarked, in doing so, upon the occurrence at Quebec of both the species, *Orgyia leucostigma* and *nova*. Dr. BETHUNE cordially seconded the motion and expressed the great pleasure that all present had experienced in listening to the address. In the course of his remarks he referred to the unusual abundance this year of the Tomato-worm, the larvæ of *Sphinx quinque maculata*, and of several species of grasshoppers and to the entire absence in his garden of the Pear-tree slug, which had been very abundant and injurious for several years previously. He stated that a friend, resident in Toronto, was of opinion that the number of house flies had been very greatly diminished by the English sparrow, which devoured the larvæ, and enquired whether this observation was correct. He spoke also of the publication of a bibliographical catalogue of the Noctuidæ of North America, by Prof. J. B. SMITH, as one of the notable events of the year.

Mr. DENTON, in putting the motion to the meeting, spoke of the value of the remedies for the Horn fly, and gave instances of herds of cattle being kept in splendid condition by being protected from the attack of this annoying insect.

The reports of the different sections for the past year were next read by their respective secretaries.

ANNUAL REPORT OF THE ORNITHOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO FOR 1892-3.

This section has held about half a dozen meetings during the year, most of which have been attended by almost every member. The approach of the collecting season, however, led to such a scant attendance that the meetings were dropped.

A ledger was opened to record the distribution, abundance, nesting habits, etc., of the birds of Middlesex and surrounding counties, on which several evenings' work was done before the cessation of meetings, and it is the intention of members to push it to completion, if possible, during the coming season.

Each member of the section has been devoting himself to the special study of one bird, and the hawk family has thus been divided between the members for report this present fall. Good results are looked for from this concentration of work.

No very rare birds were observed during the season, but the Olive-sided Flycatcher and the Fox-colored Sparrow were observed to justify the opinion of their increased local abundance, while the Tennessee warbler was unusually common for a few days in spring, and was singing freely, a habit which was not previously noted in our locality. All of which is respectfully submitted.

W. E. SAUNDERS, Chairman.
W. J. STEVENSON, Secretary.

REPORT OF BOTANICAL SECTION OF ENTOMOLOGICAL SOCIETY.

The Botanical Section held their first meeting for 1893 on April 29th, and from then till July 1st, weekly meetings were regularly held. The attendance at the meetings and the interest shown have been greater than in previous years. A careful list of the plants observed by members, their localities and dates of blossoming, has been made out. Outings to Port Stanley and to Komoka were very interesting and fruitful.

A large portion of the collection presented to the Section by Wm. Scott, B.A., of Ottawa, has been mounted by Mr. Balkwill, and the work will probably be completed during the ensuing winter. Our herbarium is increasing and we hope to make it thoroughly representative of the district.

Observations worthy, perhaps, of mention are the finding of *Moneses uniflora* and *Hypoxys erecta*, growing plentifully at Komoka, these being the first records for that district for some years at least. *Hedeoma Drummondi*, not mentioned by Macoun, and in late editions of Gray said to extend from Ohio southward to Texas, was also found near Komoka. A remarkable case of fecundity of the Beech is reported by Mr. Balkwill, who finds the cupules containing as many as six nuts each. Mr. Moffat found several specimens of *Aphyllon uniflorum* growing near the city, not before reported nearer than Port Stanley.

W. T. McCLEMENT, Secretary.

REPORT OF THE MICROSCOPICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

I have much pleasure in placing before you the annual report of our Section. It is now three years since this section was organized, and we can look back with pleasure on the work of the past few years.

Thirteen meetings were held during the season which has just closed, from October 22, 1892, to May 19, 1893, when our section adjourned during the summer months. Our total membership numbers fourteen, an increase of fourteen per cent. since last year, with an average attendance of (13) thirteen, an increase of 45 per cent. over last year, which shows the interest the members are taking in this part of the work.

The work undertaken by the Section has been of a very practical and useful character. Members have been thoroughly drilled in the cutting of sections, staining and mounting them. During the past year we have had several outings, when the manner of collecting material has been practically demonstrated, and we feel confident that this method of work adopted by our Society will make our members skillful in microscopical manipulation and will also acquaint them with all the uses a microscope can be put to.

Several new microscopical (fungi) plants have been added to the list and their life history worked out.

We are deeply grateful to the parent Society for the very liberal manner in which they have supplied us with periodicals and the great encouragement they have given our Section. We are sure that in return the Section will become a valuable adjunct to the Society.

The subjects for the various meetings during the season were as follows :

Oct. 22nd, 1892 : Open meeting. Examination of pond water. Discussion as to arrangement of meetings for the term. Each member is assigned a subject which he is expected to work up as far as possible and then report on it.—J. M. DENTON, Chairman.

Nov. 6th : Study of Desmids, by J. H. BOWMAN. Closterium and many others exhibited and described.

Nov. 20th : Open meeting.

Jan. 6th, 1893 : Reports of outings during Christmas holidays. Business meeting.—J. M. DENTON, Chairman.

Jan. 20th: (1) Clothes moths, by J. DEARNESS. An article by JAMES FLETCHER was quoted upon clothes moths, Tineola Biselliella, from 23rd Annual Report, page 53. Samples of fabric damaged by this insect were examined.

(2) Desmids. 1st, how to collect; 2nd, where to collect: 3rd, what to collect, either as useful, beautiful or scientific objects, by J. H. BOWMAN.

Feb. 3rd: Study of urinary deposits and what they signify, by Dr. J. P. BURKHOLDER.

Feb. 20th: Two lectures were delivered by Dr. J. P. BURKHOLDER on the Mounting of Animal Tissue and Preparation and Staining.

March 3rd: Mounting of Animal Tissue continued. The use of the microtome, by Dr. J. P. BURKHOLDER.

Several very interesting sections were prepared and mounted under the lecturer's instructions.

April 7th: Three lectures were delivered on Vegetable Tissue, by J. DEARNESS.

Preparation of Vegetable Tissue.

April 21st: Staining of Vegetable Tissue, by J. DEARNESS.

When is double staining necessary? Alum cochineal as a stain. Picro lithium carmine as a stain. Several specimens of ferns were stained.

May 5th: The mounting of Vegetable Tissue, by J. DEARNESS.

The several specimens of ferns which were stained last evening were mounted.

May 19th: Report on the Examination of Dawson's Pond, by J. H. BOWMAN,

A microscopical exchange was arranged with A. ALLEN, of London, Eng.

All information as to the Society's microscopes, books and mounts, the number of members owning microscopes, will be found in "The Microscope," page 38, vol. 1, No. 3. (Washington, March, 1893.)

All which is respectfully submitted.

H. A. STEVENSON, Secretary.

REPORT OF THE GEOLOGICAL SECTION.

With regard to the work accomplished by this section of the Society: The surrounding district of London has been searched wherever an outcrop of the base rock could be found exposed from the overlying lacustrine and boulder drift. The bed of both forks of the river Thames as far as Dorchester and St. Marys in one direction, and Kilworth and Komoka in the other, including a very good exposure of the quarries at Springbank, as also some miles of the river midway, were searched and found to yield many good specimens of Phalops, Bufo, Strophomena, Spirifers, Stricklandia, Orthis, Spirigera and a very peculiar specimen of the squid tribe, possibly an Omioceras. Some of the members have extended their researches further afield, and in the gorge of the Grand River at Elora and Galt have unearthed Phragmoceras, Oncoceras, Megalomus Canadensis, Lituiter, Bellerophon—a fine specimen of the last was obtained from the cliff above Wiarton. The Rev. C. H. Andras, who has lately joined the society and has proved a very active member, has added very much to the knowledge of the fossils and minerals of this portion of Ontario and has visited also the mineral regions north of Lake Huron, discovering traces of gold in a blue quartz matrix in various districts along a line of 200 miles following the route of the C. P. R., specimens of which, as well as those of the copper, nickel and silver of these districts of mineral wealth have been exhibited to the society and now form a portion of the private collection of the professor at Huron College.

During the year a report appeared in the local press that coal had been discovered in the Lambton formation at Kettle Point. To verify this the chairman (Dr. Woolverton) accompanied by Profs. Andras and Sherwood, visited the district in question and found thin bands of bituminous coal in the Devonian shale which crop out at this point. It is questionable, however, whether workable coal could be obtained here, for a few miles

south of this—at Ilderton—a boring was made through this shale formation which proved only natural gas in a small quantity and upon being continued deeper, a bed of salt was reached which is now being worked—the salt works being lit by the gas thus obtained. Perhaps the most remarkable objects in the vicinity of Kettle Point are the globular concretions of semi-crystalline limestone, ranging in diameter from two to six feet and of an internal radical structure and bituminous in nature. Several specimens were obtained and brought home by the party. In all these expeditions the local collections have been visited and their cabinets overhauled and exchanges made of duplicates. An interesting point to Geologists is Thedford and its vicinity—the railway cutting close by abounds in specimens of spirifers, orthoceras and fossil corals in great abundance, Favosites Cyathophyllum and Helliolites Halli. A fine collection of the local fossils has been made by the Rev. Mr. Currie, the Presbyterian pastor. A great need of geological maps of the peninsula has been felt to enable this society to carry on its work more thoroughly and profitably. The library on the other hand is well supplied with Geological literature which this section highly appreciates, but would gladly welcome any additions of more recent publications as they appear. The want of room greatly contracts the possibilities of the society. It has now been felt, and the feeling is widely expressed, that the time has arrived for the society as a whole to obtain more commodious premises, in order that not only the parent Society should have more room for the display of its own fine collections of insects (at present by no means shown to advantage owing to the difficulty of access by three flights of stairs and the crowded condition in which they are arranged), but also that the sub-sections might each have the opportunity of making a display of its collections. This branch at least feels that from its progress and increase of numbers this is worthy of the consideration of the parent Society. We have the honor to submit to this Society the foregoing as our report for the year past.

S. WOOLVERTON, Chairman.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year :

President—W. Hague Harrington, Ottawa.
Vice-President—J. Dearness, London.
Secretary—W. E. Saunders, London.
Treasurer—J. A. Balkwill, London.
Directors—Division 1—James Fletcher, F.L.S., F.R.S.C., Ottawa.
" 2—Rev. C. J. S. Bethune, F.R.S.C., Port Hope.
" 3—Gamble Geddes, Toronto.
" 4—A. H. Kilman, Ridgeway.
" 5—R. W. Rennie, London.
Librarian and Curator—J. Alston Moffat, London.
Editor of the "Canadian Entomologist"—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.
Editing Committee—J. Fletcher, Ottawa ; H. H. Lyman, Montreal ; Rev. T. W. Fyles, South Quebec ; J. M. Denton and J. H. Bowman, London.
Delegate to the Royal Society—Rev. T. W. Fyles, South Quebec.
Committee on Field Days—Dr. Woolverton, Messrs. McClement, Elliott and Stevenson, London, and one representative from each section.
Auditors—J. H. Bowman and J. M. Denton, London.

A paper was then read by the Rev. T. W. FYLES on "Entomological Mistakes of Authors," which was highly enjoyed and appreciated by all present.

Mr. FLETCHER drew attention to one point in the report of the Omithological section viz., the success achieved by devoting observations to one bird alone, and urged that this principle should be adopted by Entomologists, so that each one might work out the life-history of some particular insect.

The meeting adjourned at 10.30 p.m.

THURSDAY—MORNING SESSION.

The meeting was called to order by the Vice-President at 10 o'clock a.m.

A paper by Mr. A. H. KILMAN, of Ridgeway, was read on a supplementary list of Coleoptera not previously recorded as taken in Canada This paper, being of a technical character, will be published in the *Canadian Entomologist.*

Dr. BETHUNE read an extract from a newspaper, which stated that farmers in England were much alarmed because dead insects, especially grasshoppers, had been found in numbers in the recent large importations of hay from Canada. The purchasers feared that the animals fed upon the hay might receive injury from consuming the insects, and the farmers were afraid that through the importation of the bodies of the insects the eggs of the locust might be introduced into England, and a locust plague be occasioned in the country. The despatch went on to state that " Miss Eleanor A. Ormerod, the great insect authority of England, the consulting entomologist of the Royal Agricultural Society of England, and special lecturer on economic entomology at the Royal Agricultural College of Cirencester, and who is also the English corresponding member of the Entomological Society of Ontario, has published very reassuring statements, which are calculated to allay all alarm. She says that it is unlikely that locusts will propagate in Great Britain, owing to the comparatively moist and cool climate. She also declares that there is no evidence whatever that locusts are at all prejudicial to the health of cattle that eat them." Dr. Bethune gave it as his opinion that the fears of the English farmers respecting the importation of our locusts were perfectly groundless, and there was no likelihood of eggs being hatched and colonies established from the dead insects carried over in bales of pressed hay.

The remainder of the morning was spent in the examination and determination of specimens, many rare and interesting forms having been brought to the meeting by Mr. Fyles, Dr. Bethune and some of the local members. After comparing notes on various matters of entomological interest, the meeting, which was greatly enjoyed by those who were present, was brought to a close. Much regret was expressed by all at the absence of the President, whose address will be found in the following pages. The members from a distance were much gratified at the kindness and hospitality rendered them and desire to record their hearty thanks to their kind entertainers.

ANNUAL ADDRESS OF THE PRESIDENT.

By W. HAGUE HARRINGTON, OTTAWA.

While the earlier incumbents of an office, such as I have had this year the honor to hold, are fortunate in finding new lands through which to wander and from which to garner fresh crops, those who come in later years have, at least, well laid-out fields to till and good plain paths to follow. As the President's address is published in the Annual Report which our Society prepares for the Ontario Department of Agriculture, and as the address is often his only contribution to the Report, it becomes almost imperative that it should be of as economic and practical a character as possible, and at the same time be worded, in such a clear and simple manner, that it may be readily understood, not only by the members of our own society, but by the larger audience reached by the Report. Instead, therefore, of endeavoring to treat technically, or elaborately, of any of the many special branches of Entomology, I shall keep in the well defined paths which my predecessors in office have laid out.

A city residence and official duties, which for several weeks in midsummer prevent any observations, combine to cause my work in Entomology to lack the continuity which is necessary for a thorough investigation into the life-histories of our insect foes and friends. The assistance of fellow-workers enables me, however, to say a few words about some of the more noticeable insects of the past season. Of these I shall first mention

several species of saw-flies, as I have endeavored to give somewhat special attention to the extensive and injurious section of phytophagous (plant-eating) Hymenoptera, to which these insects belong. I have not yet had time to catalogue all the species recorded from Canada, but I find that we have in the immediate neighborhood of Ottawa about one hundred and sixty species, of which several are decidedly obnoxious pests. Saw-flies are so named because the female has the ovipositor saw-like in form, and fitted to cut a slit in the leaf or twig in which she desires to deposit her egg. The worm hatched from this egg is not a footless maggot, such as that of the other sections of the Hymenoptera, but is provided with both thoracic and abdominal feet, is able to travel about in search of fresh food, and has much resemblance to the caterpillars of certain moths. The worms feed upon the tissues of the leaves, and, when numerous, soon strip the plants attacked. A good example of the ordinary saw-fly larva is the worm that is so troublesome on gooseberry and currant bushes, when they are not carefully sprinkled with hellebore.

The Larch Saw-fly (*Nematus Erichsonii*, Hartig.)

It would be almost impossible to calculate, and very difficult even to imagine, the enormous loss occasioned in the tamarack forests of Canada, during the past decade, by the inconspicuous insect which has become known to Entomologists as the Saw-fly of the Larch. The first mention of it in the Annual Reports of the Entomological Society of Ontario is found in that for the year 1883 (No. XIV., page 17) where, in the account of the proceedings of the Annual Meeting, the Rev. Mr. Fyles, of Quebec, is reported as stating: "That much injury had been caused to the tamarack trees, *Larix Americana*, in Bury and the neighboring townships, by a species of saw-fly, the same, probably, as that which has caused so much injury in Maine and the other eastern States, *Nematus Erichsonii*."

The following year the same gentleman reported that: "The larch saw-fly had extended it ravages along the Beauce Valley to the neighborhood of Quebec, where it had stripped the tamaracks bare. A second growth of leaves had appeared, and this, probably, would save the trees."

Mr. Fletcher also spoke of the "enormous damage" done by this insect. He had first noticed it near Quebec, and had traced it down the Intercolonial Railway wherever any larch trees occurred, as far as Dalhousie (N.B.), where he found it abundant. He also exhibited a species of bug, *Podisus modestus*, which had been found destroying the larvæ at Brome, Que. (Ann. Rept. No. XV., p. 22.) The same Report (pages 72-77) contains a carefully prepared paper by Mr. Fletcher, on the habits and appearance of the insect.

In 1885 (Ann. Rept. No. XVI., page 12), Rev. Mr. Fyles reported: "That the insect had again been abundant at Quebec, and that tamaracks that had survived the attack of last year, now showed tokens of decay, some of the branches only putting forth a second crop of leaves, and that but a sparse one." He described the manner in which one of the fossorial wasps, *Odynerus capra*, had been observed to prey upon the larvæ. At the same meeting in "Some Notes on Tenthredinidæ, 1885," (Canadian Entomologist, Vol. XVIII., page 39), I mentioned the finding, at Ottawa on 24th June, of several colonies of the larvæ of this saw-fly upon trees near the line of the Canada Atlantic Railway.

Mr. John G. Jack, of Chateauguay, Que., in a paper read before the Montreal Branch on 9th Feb., 1886, records (Ann. Rept. XVII., page 16,) the occurrence of the destroying insects in his neighborhood as follows: "On July 5th I found some larch trees with the foliage very much destroyed by saw-fly larvæ, and on examining the trees in the woods and surrounding country, I found that they were all attacked. At this time most of the larvæ seemed to be a little more than half-grown, and they continued to feed until about July 15th, when some of them made cocoons. Many of the trees were now entirely defoliated, and the branches and twigs literally covered with the larvæ, many of which were dropping to the ground, and with the falling 'frass' made a sound like fast falling raindrops."

Prof. Saunders, at the Entomological Club of the A.A.A.S, in 1887, reported, "that in the Maritime Provinces, Nova Scotia and New Brunswick, he found the larch saw-fly (*Nematus Erichsonii*), extremely abundant and destructive." (Ann. Rept. XVIII., page 31.)

Mr. Fletcher, in his address as President in 1889, made the following brief reference to the spread of this pest: "The larch saw-fly was very abundant in the neighborhood of Ottawa, and in fresh districts in the Maritime Provinces; the tamarack swamps being rendered almost leafless for hundreds of acres." (Ann. Rept. XX., page 3.)

The Rev. Dr. Bethune, in his address the following year, referred to the species briefly: "The larch saw-fly, to which reference has been made of late years, has not been nearly so abundant as usual in those parts of Ontario where it has hitherto prevailed. It is to be hoped that its natural enemies have multiplied to a sufficient extent to keep it in subjection and prevent its undue increase." (Ann. Rept. XXI., page 7.) In 1891 he again stated that it "continues to be very abundant and destructive. Unfortunately it is a kind of attack for which there seems no practicable remedy." (Ann. Rept. XXII., page 14.) At this meeting also the Rev. Mr. Fyles presented a valuable paper entitled, "*Nematus Erichsonii*; a Retrospect" (l. c. page 28,) to which reference will be made presently.

I have now traced the progress of this obnoxious insect, as recorded in the publications of our society, but a few remarks may be added on its later ravages, and the extent to which it may have permanently injured the tamarack areas of the Dominion. While we have seen that as early as 1883 it had spread through Quebec, it is probable that it had been in Canada at least a year or two previously, but had only then reached a locality where it came under the notice of an entomologist.

My own observations along the line of the Intercolonial Railway and the Maritime Provinces, during the period elapsed since the insect was first reported, fully confirm the extent of the injury wrought in the tamarack districts, and the extent to which the trees were killed. Up to 1890, however, the insect had not, as far as I could see, invaded the Island of Cape Breton, but in the autumn of that year I found, not many miles from old historic Louisburg, a single twig with the characteristic twist and the evidence of oviposition, showing that the enemy had crossed the island. I did not find other evidences of its presence, and all the surrounding trees looked most healthy and vigorous. The worms were in this year reported as very abundant in Prince Edward Island.

The next year I did not visit Cape Breton, but in the beginning of September, 1892, just after our annual meeting of that year, I was in Sydney, and, on driving out through the surrounding country, found that the beautiful green tamarack groves and forests, which (with spruce) are in this section of country quite extensive, had the fire-swept appearance caused by the ravages of the saw-fly, and I was informed that in the previous summer they had been almost as much defoliated. The lower portions of many trees, and small trees had, as elsewhere, partially escaped, but many of the larger trees seemed to be killed. This year the same dreary appearance was observed, and there is no doubt that very serious loss of older trees has been caused.

Whence came the obnoxious insect which has so devastated and disfigured our beautiful woods and by what route did it invade our territories? Apparently from Europe, whence have come many of our most injurious insects, and, unfortunately, but few beneficial ones, and probably through the New England States. The first record that I can find of its appearance in the New World is contained in one of Dr. Hagen's "Entomological Notes", (Can. Ent. Vol. XIII., page 37), where he identifies specimens of larvæ, received from Harvard Arboretum in 1880, as agreeing perfectly with the description and figure of *Nematus Erichsonii*. These larvæ, it may be added, had been discovered feeding on European larches, and at first the native larches appear to have escaped.

In Maine in 1882 the spread of the insect was very extensive, and in the same year it occurred in Massachusetts, New Hampshire, and New York, proving that the insects had multiplied and spread with most astonishing rapidity. The United States Entomological Commission made examinations, in this and following years, of the infected districts, and in its very valuable Report on Insects Injurious to Forest and Shade Trees (1890), Dr. Packard gives a full account of the insect and its ravages. In his Report for

1884, he summed up the condition of the larches as follows, and he thinks that the prediction therein contained, was almost verified in 1885: "On the whole, then, while a small proportion of larches have been killed by this worm, this vigorous tree, though defoliated for two successive summers, seems, in the majority of ca es, to survive the loss of its leaves, though it threw out much shorter ones the present summer. Possibly 10 per cent. of our northern larches died from the attacks of this worm. Very probably the numbers of this insect will diminish during the next year, and the species may ultimately become as rare as it has always been in Europe."

The maximum of damage having been committed, and the supply of food having been correspondingly diminished, have probably led to an arrest in the further development of the insects, and their numbers may continue to decrease. It will be, however, many years before the districts ravaged by them regain their wonted luxuriance of vegetation, and the larch forests which they have destroyed will in many instances be replaced by spruces (Maritime Provinces) cedar (Quebec) or other trees which may find the vacated localities suitable for their propagation.

In the paper by the Rev. Mr. Fyles, already mentioned, he gives some figures to show the amount of injury done in the one Township of Bury, in the County of Lennox, Quebec, and an application of these estimates for one square mile, to the extended areas of trees destroyed in the several Provinces, will give some idea of the actual money value of the damages inflicted upon our possessions by this unwelcomed immigrant. "As we have seen, there are in Bury 640 acres of tamarack, giving on an average forty marketable trees to the acre, or 25,600 such trees in all. Every tree contains at least 400 feet, board measure, of lumber. This gives for the whole forest 10,240,000 feet, which, in a sound condition, would have been worth $30,720," at $3 per 1,000 feet on the stump, "and which left standing, would, under favorable circumstances, have been increased in value." He places the total loss to the township at $50,000, and to the adjoining Township of Lingwick at double that sum, and in consideration of the wide extent of the insect's depredations, he comes to the conclusion that "*Nematus Erichsonii* has been the worst insect pest that has ever visited the Province of Quebec." Regarding the re-growth of the trees, he adds: "The tamarack forest of the Townships is a thing of the past. There seems to be a law of nature, that, when one growth of trees is swept away, another of a different kind shall succeed it. The hemlocks and pines of our mountain sides give place to the poplar and the white birch. The tamaracks will probably be succeeded by the American arbor-vitæ, or white cedar (*Thuja occidentalis.*) And, if there were no such natural law, the world is too old, its population too vast, and land in the temperate regions too valuable, for us to suppose that large tracks of lowlands will be left in a state of nature for 200 years to come."

Although this insect has probably come to us from Europe, it is not there the same prolific pest which it has become under the stimulus of our more extensive tamarack forests, a change of climate, and, perhaps, escape from hereditary parasitic foes. It was described and named in 1838, and Cameron gives its continental distribution as Sweden, Denmark, Prussia, Holstein, Harz, Bohemia, Holland and France. The only country in which it is reported as injurious is Germany. In Great Britain "it does not not seem to be a common species. I have only seen a specimen taken by the Rev. T. A. Marshall, of which I do not know the locality. Mr. Dale records it from Glanville's Wootton." Its parasites are given as *Perilissus filicornis* and *Pteromalus Klugii*, Rtz. The former genus has not been recorded from America, but the latter species may possibly be identical with the parasite of which D. Packard bred considerable numbers in 1882, and to which he gave the provisional name of *P. nematicida.*

For descriptions of the insect and further information as to its habits, reference can be made to the excellent paper by Mr. Fletcher in Ann. Rept. No. XV. Cameron states that the male is unknown, and from all the larvæ we have bred there has not emerged a single male. I have, however, one male, taken in a tamarack swamp on the 15th June, 1889, which seems to belong to this species, differing from the female chiefly in having the antennæ, except two basal joints, and posterior legs almost rufous, and the sides of prothorax almost white.

Rose Saw-flies.

A new saw-fly made its appearance this year upon my roses, so that there are now three species attacking these favorite plants. One of these has been known for many years to the lovers of the rose as a troublesome pest, which rapidly destroys the foliage if not promptly looked after. This is *Monostegia rosæ*, Harris, described in 1841 and then placed in the genus Selandria, which has since been sub-divided. Although named in America there is very little doubt that it came from Europe, where it is well known as a troublesome insect, and where several names have been subsequently bestowed upon it. The small stout black flies are abundant in May and June, and the eggs are deposited in the under surface of the leaf, generally near the edge.* The slug-like larvæ feed, at night, upon the upper surface of the leaf and cause it to become brown and withered. In about a fortnight they are fully grown and drop to the ground in which they construct an earthern cell to shelter them until they pupate and emerge the following May or June. There appear to be but two mentions of this saw-fly in our reports: The first by Mr. Gott, of Arkona, in 1878 (Ann. Rept. No. IX, page 57), who stated that it was becoming very abundant and troublesome; the second in my paper on Saw-flies (Ann. Rept. XV, page 70) where its habits are concisely stated.

The second of our pests has not been long known to us, as such, but probably it crossed the ocean many years since, as it was named by Harris about fifty years ago as a new species. This insect is called *Cladius pectinicornis*, Fourc., (*C. isomera*, Harris), and its larva may be called the Bristly Rose-worm to distinguish it from that of the previous species. Dr. Riley, in an interesting article on "Rose Saw-flies in the United States," records this species as first discovered on his rose-bushes (Washington) in 1880 (Insect Life, vol. V, page 7), and it is also several years since I first bred the insect from larvæ taken on a rose-bush in Ottawa, although I cannot find a record of the exact date. I have since bred the species on two or three occasions, and find that it is becoming more abundant. In 1891 I took a specimen at the High Falls on the Des Lievres about 50 miles from the city. The species is apparently double-brooded here (in Washington three-brooded) as the flies appear from May to July. The eggs are laid in the leaf-petioles and hatch in a few days. The larva feeds on the under surface of the leaf, remaining concealed there, and at first making small holes; but these holes increase in size and number with the rapid growth of the grub, and in a few days nothing will remain but the midrib and some of the stronger laterals. The larva is greenish, with an almost orange head and with rows of small warts from which rise rather stiff bristles or hairs.† When fully grown a delicate thin cocoon, with a more or less complete outer one, is spun upon the under side of the leaves or branches, or in rubbish upon the ground. The pupal state of the first brood lasts about a fortnight, but the second brood passes the winter in this form. The flies are considerably larger than those of *M. rosæ* and have the legs and wings paler.

The third species, which has been noticed here for the first time this year, is *Emphytus cinctus*, Linn., of which the larva may be distinguished as the curled Rose-worm, from its position when at rest. This is also a well-known European species, which received a new name (*cinctipes*) from Norton in 1867. This species was first reported as a rose-pest in America by Mr. John G. Jack, who found it very injurious in Boston and Cambridge in 1887 and following years. The eggs are laid singly on the under side of the leaf, but there may be several on a single leaf. The larvæ are smooth cylindrical worms, somewhat stouter toward the head, (which is tawny with a black patch on vertex) and are greenish or yellowish-green above and whitish below. They feed on the edges of the leaves until these are consumed, and when at rest are coiled spirally beneath a leaf, or on the stripped stems. When fully grown they are said to generally pupate in the rose-branches, or in rotten wood or pith. Those that I bred this summer, however, buried in the ground in preference to using the pieces of corn pith which I had provided for them. There are probably two or more broods of this species here, as in the United States and

*Cameron states of the European insects that, "The eggs are laid in the midrib in May," and that, "The small oval cocoons are spun in the earth."

†It may be mentioned here that the description given by Dr. Riley does not quite agree with that given by Cameron of British larvæ.

Europe, although I only observed one this year. The worms of this brood finished feeding about the end of June, and the flies (of which I obtained five females and one male) emerged at different dates during July. The flies are about the same size as the preceding species, but may be readily distinguished from them by the banded legs, while the females have also a white band across the abdomen. Although the larvæ were noticed this year for the first time, it may be stated that Mr. Fletcher gave me last winter a male, which had been previously captured by him.

While these three species of saw-flies are troublesome and rapidly defoliate neglected plants, they can be quite easily destroyed and kept in check, by a careful spraying at necessary intervals during the season, with a solution of hellebore made by using an ounce of the drug to a gallon of water.

THE PEAR TREE SLUG, *Eriocampa (Selandria) cerasi*, Peck.

Slug-like larvæ apparently identical with those which have been mentioned in previous Reports, (Nos. V, VI, IX, etc.) as attacking pear and cherry trees, were this year very abundant at Ottawa upon Mountain Ash and Cratægus. This worm, Fig. 9, is, when young almost black, or appears so on account of a slimy secretion with which it is covered; the front portion of the body is much enlarged, and the head thereby almost concealed. When fully grown it is almost half an inch long, and after the final moult the color is yellow and the skin is free from slime. There are altogether five moults; the cast off slimy skins adhering to the leaves. The insect feeds upon the upper surface of the leaf, causing at first a small whitish patch, but as the epidermis of the leaf is devoured more and more rapidly with the enlargement of the worm, the foliage of a badly infested tree soon has a dark withered appearance and commences to drop off. Pupation takes place in the ground, in cells lined with a sticky substance, which forms a species of earth-encased cocoon. The species is double brooded; the flies of the first brood emerging about a fortnight or three weeks after the larvæ bury; those of the second not appearing until the following spring. The larvæ were noticed in the summer of 1892, but were much more abundant this year, and greatly disfigured some of the ornamental trees in the city. The attack was most severe upon the variety known as Oak-leaved Mountain Ash (*Pyrus acuparia* var. *quercifolia*) the American form suffering comparatively little. The ravages of this saw-fly, Fig. 10, may be easily checked by spraying either with hellebore or paris green. Although the larvæ were so abundant I have not been able to recognize a single specimen of the fly among my captures, and specimens which I was breeding this summer of the first brood emerged during my absence from home and were so badly moulded as to be unrecognizable.

Fig. 9.


Fig. 10.

THE CORNEL SAW-FLY, *Harpiphorus tarsatus*, Say.

In *Insect Life* (Vol. II, page 239-243) is an article on "The Dogwood Saw-fly," which supplements a paper which had been contributed to *Garden and Forest* by Mr. J. G. Jack under the title "A Destructive Cornel Saw-fly (*Harpiphorus varianus*, Norton)." As this insect is also found to attack Cornel in Canada a brief mention of it may not be out of place. But before noting its operations I would like to point out that my observations go to show, as I have already indicated (*Can. Ent.* vol. XXV, page 59) that *H. varianus*, Norton, is only a paler form of the species described by Say in 1835 (Le Conte Ed., vol. II, page 679) from Indiana, under the name *Emphytus tarsatus*. *H. versicolor*, Norton, and *H. testaceus* of same author are also apparently forms of the same insect, which is variable in colour. The proper name for the species would, therefore, appear to be *Harpiphorus tarsatus*, Say, with *varianus*, *versicolor* and *testaceus* of Norton as variations, and it may perhaps be better to call it the Cornel Saw-fly, as in some portions of Canada the name Dogwood is not always confined to these shrubs. The flies appear at Ottawa in June and the early part

of July, and the eggs are then laid in the upper surface of the leaves, the larvæ, when hatched, emerging on the under surface, where they rest coiled up out of sight. During the earlier stages the larva is covered with a white bloom, or efflorescence, which is very easily removed. The head is black, and the feet and under portions yellow. When the last moult takes place the appearance of the larva is greatly changed; it becomes of a bright yellow with rows of black spots along the back and sides, and is no longer covered by the white powdery excretion. Pupation takes place in burrows bored in dead branches, pithy stems, decaying wood, etc., a habit which in some localities is evidently a preservative one, as the land may be flooded for a considerable time in the spring, and if pupation took place in the ground many of the insects would probably perish. The native species of Cornel upon which I have observed them is *Cornus stolinifera*, but at the Experimental Farm they have this year been abundant enough upon *C. sibirica* to be quite injurious. Mr. Fletcher, who has been rearing a number of larvæ from these shrubs informs me that two species seem to be indicated, one being much larger and somewhat different in markings from the other, but until the flies emerge next season this cannot be decided. Under date of 7th Aug., Miss Rye, of Niagara, writes to Mr. Fletcher that the previous week these larvæ had appeared upon her ornamental dogwood trees in immense numbers and had greatly injured them. Upon ornamental plants, however, the depredations of this insect may be easily checked by spraying with the usual Paris green solution.

The Fall Canker Worm, (*Anisopteryx pometaria*, Harris).

The next insect which I desire to mention is by no means a recent intruder, but one which has been frequently brought to the notice of our members and the public at large. I refer to that very destructive insect the Canker Worm, (*Anisopteryx pometaria*). This species, and the very similar *Paleacrita vernata*, Peck, were clearly described for us many years ago by the then President of the Society, Prof. Saunders. (Ann. Rept. VI., p. 26, 1875), and were illustrated by the beautiful figures of Prof. Riley.

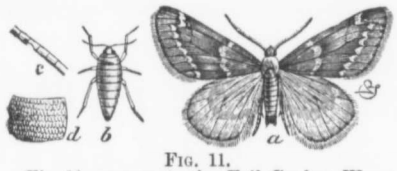

Fig. 11.

Fig. 11, represents the Fall Canker Worm *A. pometaria*; *a*, the winged male; *b*, the wingless female; *c*, a portion of an antenna magnified; *d*, segment of larva, magnified,

Fig. 12.

Fig 12, the Spring Canker Worm (*P. vernata*); *a*, the winged male; *b*, the wingless female; *c*, a portion of an antenna magnified; *d*, segment of larva, highly magnified.

It is nearly a century since Prof. Peck, one of the earliest of American entomologists, penned his "Natural History of the Canker Worm," which even then was making itself known as a depredator in the New England orchards. Our two species of moths resemble each other so very closely, both in the larval and adult stages, that the trained entomologist alone can readily distinguish them. This, however, is not a matter of very great importance from the economic standpoint, as the habits of both species are identically the same, and the same course of treatment will destroy the one or the other.

The species are generally distinguished as the spring and autumn Canker Worms, but the larvæ of both species appear in early summer and have the same pernicious habits of reaping where they have not sowed. These larvæ are pale greenish "loopers" when young, becoming more striped and darker with successive moults. Voracious eaters, they rapidly defoliate the trees upon which they feed, and when fully grown they drop, by silken threads, to the ground, to burrow a few inches below the surface and construct a cell in which to pupate, the moths appearing partly in the autumn and partly in the spring.

In his address last year Dr. Bethune made mention of the abundance of Canker Worms at several places in Canada, one of these being Ottawa. Having watched the

appearance of the pest during the past three seasons, I wish to make a few remarks upon the species which has been the cause of so much disfigurement of our shade and forest trees. The past summer was the third in which the attack has been severe, but there are indications that the crisis has been passed and that we shall probably next year have a less numerous host at work. The species which has been infesting our district is that known as the Fall Canker Worm, *A. pometaria*, and I am informed by my friend Mr. Fletcher, who has a fuller knowledge of the lepidoptera, that the other species (*vernata*), does not occur here.

While a variety of trees have been more or less injured, it was easily observed that the basswoods were one of the favorite objects of attack, and the large succulent leaves of this densely foliaged tree were speedily riddled, and entirely eaten away by the swarms of caterpillars. In 1892 the ash trees suffered very much, and in many localities were also almost defoliated. In one locality especially, where some fine trees grew on the margins of a low meadow, the excrement dropped by the feeding swarms pattered like a heavy shower on the ground beneath, and walking beneath the trees was rendered most unpleasant on account of the scores of dangling worms, fallen from aloft and swinging to and fro on their silken lines. One soon got liberally sprinkled with worms, and at the same time had the unpleasant sensation of the threads across his face like so many strong cobwebs. The caterpillars which had fallen were of course anxious to return to the feast, and could be seen crawling upward upon every trunk. A natural result of this upward movement was, that all that got on one's clothing soon reached the collar, where they circled around in a most disagreeable manner seeking a way to go still higher, and liable to be crushed by any movement of the head.

This year the attack in that locality was much lessened, either through the influence of predaceous and parasitic enemies, or by flooding of the ground in the winter and spring. Groves of hickories (*Carya amara*) on the higher land adjoining, were pretty well defoliated, but here the Canker Worms were assisted in their work of destruction by several other species of caterpillars. The Canker Worms were most abundant during the first week of June, but by the 20th they were mostly finished feeding and had dropped to the ground. During the period of their presence upon the trees I tried to

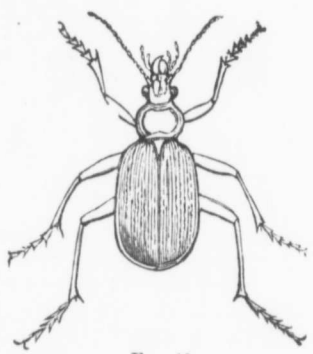

FIG. 13.

FIG. 14.

observe as often as possible the enemies by which they appeared to be attacked, and it has been encouraging to find that some of these have increased rapidly in numbers, concurrently with the increase of the worms. This has been especially noticeable in the case of the fine beetle *Calosoma frigidum*, Kirby, which belongs to the same section of the genus as *C. scrutator*, Fig. 13, and *C. willcoxi*, the beautiful large green beetles which occur plentifully in some parts of Ontario, but whose range does not extend as far eastward as Ottawa. The tree climbing and larvæ-seeking habits of these splendid insects are well known, and *frigidum*, which has a more northerly and easterly distribution, appears to have the same arboreal and predatory habits. Our other common species, *C. calidum*, Fig. 14, is essentially a ground beetle and is a most persistent destroyer of cutworms. While

frigidum has the more graceful shape of the *scrutator* group, it is quite black, and bears three rows of small bronzed or greenish punctures, which are, however, much less conspicuous than those of *calidum*.

As an evidence of the rapid increase of *frigidum* during the recent infestation of Canker Worms, it need only be mentioned that my first capture of this beetle was on 23rd May, 1883, on an island about three miles below the city, and that no other specimen was taken by me until 28th June, 1891. During these eight years a careful watch had been kept for this species, and many additions of less conspicuous beetles had been made to my local lists, so that I was forced to the conclusion that it was one of our rarest species. In 1892, however, as recorded in *Ottawa Naturalist* (Vol. VI., p. 150), I found several specimens in a locality where the Canker Worms were very numerous upon ash trees, and also took two specimens in the city. This spring the beetles were found to be quite abundant under stones, etc., in the infested localities, and later when the worms made their appearance on the foliage they were soon attacked and greedily devoured by the beetles. Numerous examples of *frigidum* were seen ascending the trunks of the basswoods and extending their investigation as high as they could be watched. The worms seemed to be easily disturbed by the marauders, and when a beetle ran out on a leaf they would drop down a few inches to elude it. One of the less alert, or newly moulted worms, would, however, be captured, and it took a very few seconds for the beetle to devour the juicy body of its prey and to recommence the hunt. Enormous numbers of the worms must have been thus devoured by this beneficial beetle. At the Experimental Farm, the beetle was also found in some numbers on infested basswoods, showing that its range was becoming more extended.

The Canker Worms were also attacked by parasitic hymenoptera, which, though less conspicuous, may not have been less destructive than the beetles. One of these which I have bred is apparently *Apanteles paleacritæ*, a Braconid, described by Prof. Riley, (Trans. St. Louis Acad. Science, Vol. IV., p. 313), from 3 females, 1 male, bred from the larvæ of *Paleacrita vernata*, found at Villa Ridge, Southern Illinois, the flies appearing May 10th, and from 2 females bred from Canker Worm larvæ, probably of the same species, received from Mr. J. Pettit, Canada West. This Apanteles differs from *A. congregatus* and other common allied species, in that the host only supports a single larva, which, however, seems to so exhaust its vitality that it does not reach maturity. Dr. Riley says that: "The greenish white cocoons are spun singly on the under side of a leaf," but I have often found that the parasitic grub, when satiated with the juice of the unfortunate Canker Worm, emerges from its back and spins its cocoon thereon; the emaciated worm bearing this upright burden, like a tower on his back, wanders feebly about until death claims and relieves him.

On the hickories I found numbers of the Canker Worms which had succumbed to a different internal parasite, and had become mere contracted and stiffened shells, attached to the leaves and stems on which they had died. Such a condition results with some caterpillars from the attacks of species of the Ophionid genus Limneria, and perhaps may have so resulted in this instance, but from a number of specimens collected I bred invariably a species of Hemiteles, the members of which genus are considered secondary or hyper-parasites. I have not yet had time to thoroughly identify the pretty little species bred from the Canker Worms, but it resembles *H. sessilis*, Prov., in having two well defined bands on the wings, although evidently a distinct species, and closely related to *H. melitæe*, Ashm., if not identical with that species, which occurs in California. Another ichneumon which was quite common about the infested hickories was the handsome *Mesostenus thoracicus*, Cress, usually a rare insect, and I supposed from its unusual abundance that it was parasitic on the Canker-worms. After closely watching their movements, however, I ascertained that they were searching for the rough cases made by a species of leaf-folding caterpillar, and that they perhaps confined their attention to this species which was somewhat abundant. I collected some of the folded leaves and bred from them both the parasite and the moth, the latter a pretty little species, which Mr. Moffat has kindly identified for me, and of which he says: "The name of the moth is *Ambesa Walsinghami*, Rag, as identified for me by Prof. Fernald from a single specimen taken at Hamilton several years ago, and I have never met with another. It belongs to

the Phycitidae and Hulst gives its habitat as Cal., but gives no intimation of its food plant." In addition to this insect and the Canker-worm, there were several geometrid and other larvæ infesting the hickories, but I had not the time to collect or examine them.

While the Canker-worm is a very destructive insect, it fortunately does not extend

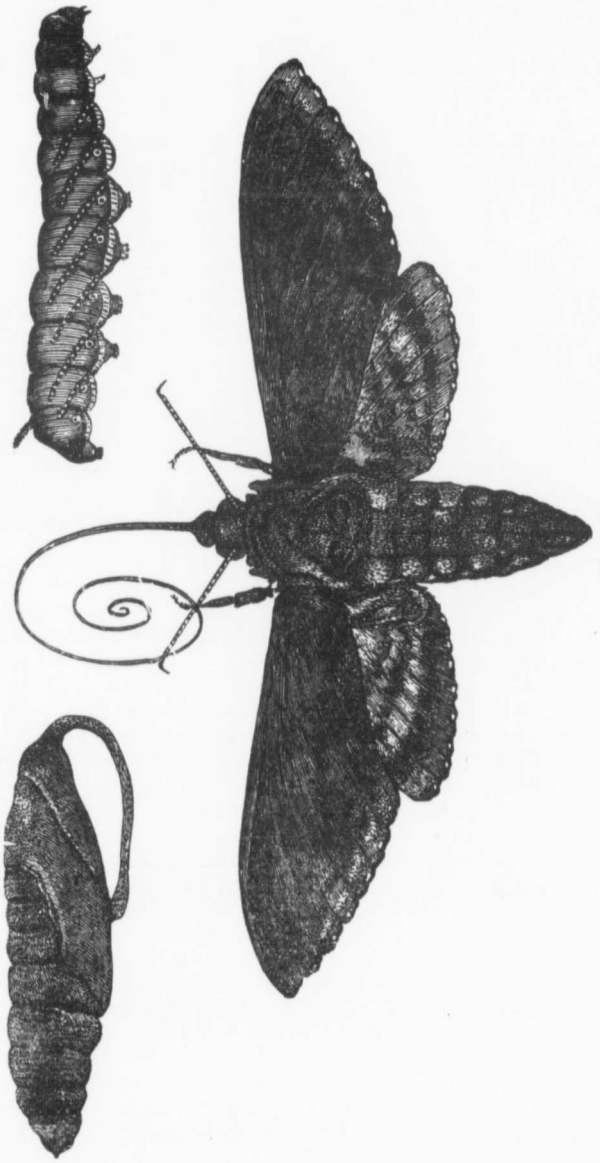

FIG. 15.

the area of its ravages very rapidly, as the females are wingless, and generally deposit their eggs upon the trees beneath which they have emerged from the ground where the caterpillars buried for pupation. The insect is thus not a difficult one to deal with when it infests the orchard or shade trees. The females may be prevented from climbing

up the trunks by means of sticky bands or funnel-shaped collars of tin. When thus stopped they often deposit their eggs below the obstruction, where they may be easily scraped off or destroyed by brushing with coal oil. When the attack is not observed until the worms are feeding, they may be sprayed with Paris green (one pound to 200 gallons of water), or may even be jarred from the trees and then destroyed. If they have been allowed to become full grown, and have buried themselves, plowing to the depth of a few inches, late in the autumn will expose them to the frost. The spraying of the trees when the young larvæ are feeding is the most effectual means of destroying the insects.

Miscellaneous Insects.

The Tomato-worm, the large caterpillar of the Hawk-moth, *Sphinx quinquemaculata*, Fig. 15, which last year was reported in some portions of Ontario very destructive to both tomatoes and potatoes (Fletcher, Rept. Exp. Farms, 1892, p. 161), has not proved so troublesome this season. The decrease of this obnoxious caterpillar may be largely due to the increased abundance of the little Braconid fly, *Apanteles congregatus*, with the little white cocoons of which the worms may be sometimes found almost covered, as many as 200 larvæ of the parasite feeding and developing in one caterpillar. The Fall-Web-worm, *Hyphantria cunea*, Fig. 16, continues to be very abundant, and its unsightly webs disfigure a great many trees throughout the country, although there is no reason why its ravages should be permitted in gardens, orchards or lawns, where a little care in removing the colonies of young worms would soon greatly reduce the pest. In the Maritime Provinces it seems fully as common as in Ontario and is one of the most noticeable insects.

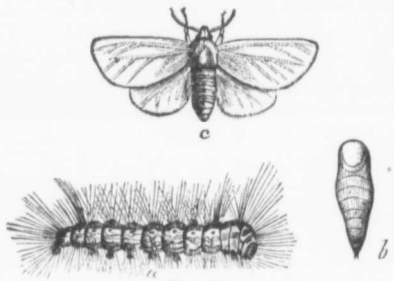

Fig. 16.

The handsome "Mourning Cloak" butterfly, *Vanessa Antiopa*, whose rich purple wings are broadly margined with golden yellow, has been in unusual abundance this year, and its black spiny caterpillars have seriously defoliated the elms and willows. Because of its beauty and of the cheerful appearance it makes in the early days of spring, we can forgive this species for a considerable portion of its depredations. It is also so subject to the attacks of a small parasite, *Pteromalus puparum*, of which a single chrysalis contains hundreds, that its increase is kept well under control without the interference of man. Another beautiful butterfly which was unusually abundant, was *Limenitis Arthemis*, which has a most charming garb of purple, variegated with shimmering blue and broadly banded with white. It is a woodland butterfly, flitting gracefully along the paths through woods or about their margins, and thus hiding its beauty from the city residents, whereas the more hardy Antiopa enjoys both city and country life.

Plant-lice of various species are a continual source of trouble and loss to plant growers and fruit-raisers, and the Apple-aphis may be cited as one of the more injurious species. Another plant-louse has badly infested the ornamental shrub known as Snowball, and much disfigured them by curling and shrivelling the leaves. The attacks of such insects can be easily treated with a spraying of the kerosene emulsion recommended by Mr. Fletcher, in Bulletin 11, Central Exp. Farm, which tells how to prepare and apply the most efficacious remedies for many injurious insects.

Several species of beetles have come under my notice as having been injuriously abundant during the year. Among those were two of our common Blister-beetles—*Macrobasis unicolor*, the Grey Blister-beetle, Fig. 17*a*, was reported as infesting potatoes,

a crop which is not infrequently attacked by this insect, and in New Brunswick it was also found destroying horse-beans, which are now being somewhat extensively grown with corn for ensilage. The favorite native food of this beetle appears to be the Meadow-rue (*Thalictrum cornuti*), but it is also quite satisfied with the foliage of the Basswoods. The Black Blister-beetle, *Epicauta pennsylvanica*, Fig. 17*b*, has been reported infesting German asters and mangels, and has been previously known as attacking carrots, cabbages, and beets. The method of attack by these two species of Blister beetles is much alike, and they sometimes may suddenly appear in very great numbers. Their depredations need not, however, be much feared, as they are only committed by the adult, or fully developed insects, and are of comparatively short duration. They may be readily checked by dusting with lime or plaster, or in extreme cases by sprinkling with paris green. In the larval stage the Blister-beetles are parasitic in their mode of life and some of the species render good service in destroying the eggs of grasshoppers. In Manitoba and the N. W. Territories a larger species, *Cantharis Nutalli*, is very abundant, and at times troublesome, and one or two species have been recorded as pests in British Columbia.

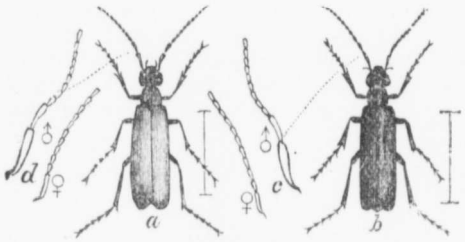

Fig. 17.

The Spotted Tortoise-beetle, *Chelimorpha argus*, Licht, was brought to me several times as a destructive beetle, but its presence on some of the plants said to be attacked was undoubtedly accidental. The larvæ of this beetle feed, in common with those of our species of Helmet beetles (Coptocycla) on the common wild convolvulus. They are disagreeable looking spiny grubs, carrying their cast-off skins upon their backs like a bundle of old clothes. Before pupating, if their food plant has been pretty well destroyed, they may wander off and attach themselves to adjacent plants. They have been said to feed on potato, and on raspberry, but, if these were carefully made observations, it is probable that the proper food plant had been exhausted, and the larvæ had sought the nearest plants. The Morning-glory, which belongs to the Convolvulaceæ, is subject to their attacks, and one instance came to my notice this season, in which serious havoc was made with the form of this creeper known as the Rose of Sharon.

In the Maritime Provinces the Pear-blight Beetle, *Xyloborus dispar*, which belongs to the Scolytidæ, or family of small bark-borers, continues to cause much alarm to the proprietors of the famous apple orchards, as it appears to attack healthy trees as well as those whose vigor has been impaired. If it continues to spread, this minute beetle will be the source of much loss, and will be extremely difficult to combat.

Grasshoppers, which two years ago were unusually abundant and destructive, especially in oat-fields, in this section of country, were, probably on account of the very wet spring and summer, much less numerous this season and comparatively harmless. In the western parts of the Province, as for instance in the neighborhood of Lake Simcoe, where dry weather prevailed, they proved very destructive ; the season being favorable to their development, while at the same time reducing the vigor of the plants subject to their ravages. The three common species occurring were *Melanoplus femur-rubrum*, *M. atlanis*, and *M. femoratus*.

The Cattle Horn-fly, *Hæmatobia serrata*, has continued to extend its area during the past season, and has undoubtedly caused a very serious loss to the stock-raiser and dairyman. While the animals may not be dangerously or permanently injured by its attacks, the irritation is so great that sores are produced by the rubbing and licking by which they strive to relieve it, and the general effect is to cause the beasts to "fall off rapidly both in flesh and in yield of milk." For further information regarding this recent and serious pest, I would refer you to the excellent paper by Mr. Fletcher in our last Annual

Report, or to his Bulletin on the Horn-fly (Central Exp. Farm, No. 14.) As the dairy and stock-raising interests of Canada are of such great importance it is sincerely to be hoped that this plague of flies is but a temporary one.

Parasitism in Insects.

This, to me, is one of the most interesting problems in entomology, and the subject has been admirably dealt with by Prof. Riley, in his address as President of the Entomological Society of Washington last year (Proc. Ent. Soc., Wash., Vol. II., pages 397-431). After a mention of the animals affected (chiefly mammals, birds and insects), he defines the scope and meaning of the term parasite, and suggests the separation of parasitic forms into three groups. First, *Parasites Proper*, including insects whose whole life is passed upon and is dependent upon their host, and which may be sub-divided into *external*, as lice, and *internal* (or sub-cutaneous), as the itch-mite, etc. Second, *Fatal Parasites*, which, in the larval stage, live at the expense of the members of their own class. These are also sub-divided into *internal*, where the larva is nourished within the host upon the surrounding fluids, as are the majority of Hymenopterous parasites, and *external*, where the larva attaches itself to the host, as in Thalessa, and sucks its juices; to this sub-division belong many hymenopterous, dipterous and coleopterous parasites. Third, *Inquilinous Parasites*, which includes the numerous forms which live upon the provision made by other species for the sustenance of their offspring, or which are found habitually associated with other insects, but not injurious to them. This class is sub-divided into *fatal inquilines*, where the guest's living means starvation and death to the host, and *commensals*, where association is mutually harmless, as where beetles are found living in the nests of bees and ants.

An outline is then given of the parasitic forms occurring in the several orders of insects, with reference to some of the principal and more interesting groups. The Hymenoptera furnish by far the greatest number of species, which, by their abundance and rapidity of reproduction, tend to check and reduce the undue prevalence of other insects. Some of the most interesting parasites belong to the Coleoptera, especially those forms of which the larvæ in the first stage are named triungulins, and which later, when the host has been reached and food assured, gradually become helpless grubs. Such are the Oil-beetles and Blister-beetles in the larval stages. The Diptera furnish the well-known Tachinid flies which deposit their eggs upon caterpillars and other insects, the footless maggot penetrating the body of the victim and feasting therein. These forms are very numerous and destroy enormous numbers of insects, such as the Tent-caterpillars, etc. The order furnishes also many other important groups of parasitic species varying much in habits, such as the bot-flies and tick-flies. We may also include under this order the fleas. In the Hemiptera are found the true lice, unpleasant little creatures, subsisting on the blood of mammals and not even exempting man, especially if he be indifferent as to cleanliness of body and raiment. The bed-bug is often spoken of as a parasite, but is so, to such a limited extent, as not to fall into any of the classes enumerated, being merely predaceous in habit, a distinction which should be born in mind, as there are many predaceous insects which do not come under the stigma of parasitism.

The Platyptera (bird-lice) and Arachnoidea (Ticks and Mites) contain numerous species, principally external irritants, but the remaining orders of insects are almost free from any parasitic inclinations.

The causes which might produce the parasitic habit are then considered, and the effects of the parasitic life, which produces degradation both by limiting the freedom of motion and by obliterating structural features common to closely allied non-parasitic forms, although at the same time certain organs may gradually become highly modified and specialized to meet the requirements of the new conditions of life. The modifications observed are both external and internal, and form in themselves an extensive subject for consideration. Finally the economic bearing of parasitism is briefly referred to, and it is shown that the agriculturist is very greatly aided by the numerous species which subsist upon phytophagous insects. The address is one well worthy of careful study, and, as has been elsewhere remarked, would serve as a basis of a very acceptable volume.

Entomological Publications.

The study of Entomology from an economic standpoint, has, of recent years, been rapidly developed in America, and the Association of Ecoromic Entomologists, organized to bring together the workers in this field of applied science, must exercise a powerful influence upon future investigations of this nature. The agriculturist will have no excuse, for remaining in ignorance of at least an elementary knowledge of his insect enemies when the results of the investigations of trained entomologists in every section of the country are so frequently and freely issued in bulletins and reports.

In Canada our Society has been a pioneer in this direction, and for more than a score of years has issued an Annual Report, which is generously distributed by the Ontario Department of Agriculture. In more recent years the Dominion Government has sought to assist and develop the agricultural interests of the various Provinces and Territories, by the establishment of Experimental Farms. These are under the direction of Prof. Saunders, for several years President of this Society, who is well-known as a writer on economic entomology, and especially by his able treatise on Insects injurious to Fruits, which is a standard text-book for fruit-growers throughout America. He is fortunate in having associated with him, as Entomologist and Botanist, Mr. Fletcher, who has also been more than once our president, and whose industry and scientific acquirements render him unusually well-qualified to occupy such a difficult and responsible position. His yearly reports and occasional bulletins are replete with information clearly and concisely expressed, and, as they are gratuitously supplied to applicants interested in these subjects, it is unnecessary for any one to suffer insect depredations to go unchecked.

In the United States the Division of Entomology at Washington, under the guidance of the most eminent of all economic entomologists, Prof. Riley, assisted by a staff of numerous trained and skilful observers, conducts most thorough investigations in all parts of the country where any pest attains unusual prominence. The publications, based upon these researches, are most valuable and reliable records of the habits of injurious species, the parasites from which they suffer and the remedies which may be most easily and effectually employed against them. A complete series of the publications issued up to date forms in itself a very valuable library. The Smithsonian Institution, in the Bulletins of the U. S. National Museum and other publications, affords to authors a means of issuing more extensive and exhaustive monographs than could be received by the regular entomological journals. Among recent issues from this great source of scientific knowledge may be mentioned the Directions for Collecting and Preserving Insects, by Prof. Riley, which is the most complete and satisfactory text-book known to me on a subject which forms the basis of all entomological study and advancement. A larger work, although appealing to a more specialized and limited class of readers, is Bulletin No. 44, in which Prof. John B. Smith gives a further proof of his untiring energy and ability in a Catalogue of the Lepidopterous Sub-family Noctuidæ, found in Boreal America, forming a volume of 400 pages.

The various State Entomologists, Agricultural Colleges and Experiment Stations swell the tide with reports and bulletins. It would take too long to enumerate even the most important of these, but mention may be made of the many valuable reports of Lintner, Comstock and Forbes, to indicate the character of the work accomplished by such professional workers in the wide field of economic entomology.

The general literature relating to insects increases with great rapidity, and the yearly additions are so voluminous as to be almost discouraging to students who desire to have, or to know, all that is being published. The record of entomological writings of 1892 (Insecta ; Dr. Sharp) gives over one thousand titles of papers. It is scarcely possible for any of us to obtain, or even see, all these writings, however much we may desire to possess, or, at least, to peruse them, but a certain number of publications are necessary if we desire to obtain a knowledge even of our own fauna.

Of these, *The Canadian Entomologist*, now completing its twenty-fifth volume, is the most essential to Canadian students, and, although dealing more especially with the insects of our own dominions, it contains many valuable contributions from wider fields, by he most noted entomologists of the day. Under the careful editorship of our late President, Dr. Bethune, it shows a steady improvement in quality and quantity of matter, and

(started Aug. 1868) enters promisingly upon its second quarter of a century. This is the only Canadian journal devoted to Entomology, but the *Ottawa Naturalist*, published monthly by the Ottawa Field-Naturalists' Club, frequently contains valuable papers and reports on the insects of the surrounding section of country. Occasional entomological contributions also appear in the *Canadian Record of Science*, and possibly in the transactions of other societies.

Of the United States' periodical publications the most important are as follows: Transactions of the American Entomological Society; *Psyche*, issued by the Cambridge Entomological Club; Proceedings of the Entomological Society of Washington: *Entomological News*, by the Academy of Natural Sciences, Philadelphia: *Insect Life*, by the Division of Entomology, Washington, and the *Journal of the New York Entomological Society*, which has recently made a brave and promising entry into the arena.

While the more advanced student may be embarrassed by the wealth of entomological literature provided for him, the beginner has hitherto found the information most needed not to be readily obtained. He has had to seek here and there a little, like the bee gathering honey, and has lost much valuable time in the search, as does the bee when flowers are scattered. A new era seems to be now opening, and the long road is being cleared and smoothed for him. Dr. Riley's directions for collecting and preserving insects enable him to prepare good specimens and to form satisfactory collections, and by the aid of Dr. Packard's "Entomology for Beginners," or Prof. Comstock's "Introduction to Entomology" (Part I. only issued) he can study their structure and classification. The next stage, the identification of specimens, without having to impose upon more advanced students the labor of naming even the commonest forms, promises soon to be covered by the issue of hand-books on the various orders, in which will be gathered generic and specific descriptions, now often scattered in foreign and miscellaneous literatures, accessible but to the favoured few.

Such a help to the determination of the diurnal lepidoptera has already been issued by Dr. Scudder, under the title of "A Brief Guide to the Commoner Butterflies of the United States and Canada." The introductory chapters narrate clearly and concisely the structure and habits of butterflies, and are followed by carefully arranged tables for readily determining the species. The omission of rare forms makes these tables less complicated without lessening the value of the work to the young students for whom it is specially intended. Each species is fully described in its several stages, and interesting facts are added in regard to its habits of life. Those who may consider themselves too far advanced to profit by this valuable little book will await with interest the author's promised "Manual of the Butterflies of North America." From the same facile pen we have also a charming little volume for the general reader, on the Milk-weed Butterfly, simply written and devoid of technicalities, yet giving not only the life history of the species selected as a type of our "winged flower," but much of interest in regard to its tribe.

The *Journal* of the New York Entomological Society informs its readers that the preparation of a Hand-book of Coleoptera found in North-eastern America is contemplated, and is now publishing a preliminary catalogue of the species, compiled, from printed and manuscript lists of various entomologists, by Messrs. Leng and Beutenmuller, who express the hope that they may be notified of any corrections or additions tending to perfect the catalogue. When this hand-book appears the Butterfly and Beetle collectors will be well-equipped, and the students of the remaining, equally important if less generally attractive, orders will await the preparation at a later date of manuals to meet their needs.

In conclusion, I have to express the great degree of satisfaction derived from the knowledge that our Entomological Society continues to find itself in a healthy and progressive condition, and to apply itself faithfully to the study of those innumerable forms of life, which, though individually minute and feeble, are in the aggregate a very important factor in modifying the conditions of existence of even man himself. Upon each fellow-member I would urge the necessity of constant work in some selected section of the great field of Entomology, for only by untiring effort, and often by considerable self-denial, can we master its problems and utilize our investigations for the benefit of others. I shall gratefully remember the honour, which I have this year enjoyed, of having been the chief officer of this important Society, and shall strive in the future, as in the past, to assist in its labors.

ENTOMOLOGICAL MISTAKES OF AUTHORS.

Rev. Thomas W. Fyles, F.L.S., South Quebec.

I lately took up Gage's Second Reader, authorized for use in the schools of Quebec, Manitoba, British Columbia and the North West Territories; and I opened it at the chapter entitled "How a Butterfly came." I was curious to know the value of the lesson in Natural History provided in this authorized work for the children of the provinces and territories named; and I read it carefully. The lesson tells that

"Late in September a lady saw a worm upon a willow leaf."

The worm is described; and a rude cut of it is given.

"The lady carried leaf and sleeper home. She took willow leaves for it to eat, put them all in a glass dish, and tied lace over it. In just one week her guest was gone; only a lovely green bag was left."

Here the bag is represented.

"It was just one inch long, was made very neatly, and looked much like a little bed or cradle. No stitches could be seen, and the seams had an edge like gold cord. Gold and black dots like tiny buttons were on it. The caterpillar had sewed himself in." . . . "Almost six weeks the little sleeper lay in his silken cradle. Early in November he burst the pretty green hammock." . . . "A lovely butterfly came out out. It had brown and golden wings, with stripes of black like cords on them, and a feathery fringe of white for each stripe On the edges of the wings were white and yellow dots. The head was black and also had white and yellow dots on it."

Here comes a representation of a butterfly—decidedly a *Papilio*.

"The inside of the wings was darker; it was like orange-tinted velvet. All these changes were in less than two months."

The caricatures of the larva and pupa given, and the descriptions of the insect in its different stages, are faintly suggestive of *Danais Archippus*; but Archippus feeds on *Asclepias*; and Archippus is not a *Papilio*. *Papilio Turnus* is, I believe, sometimes found on the willow; but the description and the cuts of larva and pupa are not even *faintly* suggestive of this species.

What insect is really meant in the lesson I am quite unable to determine; but this I can with confidence say: The Canadian child, who may be led by this chapter in the Second Reader to search the willows late in September, for banded worms two inches long, that will in a few days sew themselves into silken bags, out of which, in November, swallow-tail butterflies will come, will simply have its labor for its pains.

This wonderful lesson in Entomology upon "How a Butterfly Came" set me "a-thinking," and led me to make various mental and literary excursions. For example: I have accompanied poor "Tom" in Charles Kingsley's "Water Babies" to the "other-end-of-nowhere," and sat at the feet of "Mother Carey," and learned from her that the fairy who made butterflies was not nearly so clever as the fairy "who made butterflies make themselves." This lesson, I take it, was intended for a sly joke at the evolutionists, and suggests the question, How did the butterfly and other insects originally come?

The Egyptians told Herodotus that some living things were generated from the slime of the river and the sea; Pliny supposed that insects sprang from the dew falling upon leaves; Virgil thought that bees might spring from the corrupting bowels of slain beasts; Pietro Martire that "gnattes of divers kindes" were "ingendered of moyste heate"; Ashmole assured Pepys—at any rate Pepys tell us so in his "Diary" under date of April 23rd, 1661—that "many insects do often fall from the sky ready formed;" Swedenborg taught that worms are "procreated from the effluvia of the earth, and from the exhalation of vapors of vegetables, by which the atmospheres are impregnated;" and Du Bartas that God

> "By his wise power made many creatures breed of lifeless bodies . .
> So the cold humour breeds the salamander . . . . .
> So, in the fire, in burning furnace springs
> The fly Perausta."

All these worthies were mistaken—as much so as a very modern *savant* in the person of a little school-boy, who a few days ago told me gravely that "if I would put a horse-hair

into the water and keep it there, it would turn into a snake." He did not make a disciple of me, for I had read Cobbold's, Leidy's and Agassiz's observations on *Gordius aquaticus*, etc.

I have come to this conclusion that whether we go to the "other-end-of-nowhere," or to "the uttermost parts of the morning," we shall find nothing better to rest upon than the old statement, "God said, Let the earth bring forth the living creature after his kind, cattle, *and creeping thing*, and beast of the earth after his kind; and it was so." Gen. I, 24.

That every kind has its own well-ordered and fitting life-history we are assured, from the success that has attended the efforts of entomologists in following through their various stages of existence many of the most minute and obscure of living things.

I have shewn that an authorized school-book may be misleading—the school-master's desk is not *always* the seat of entomological authority.

From the pulpit too, hard sayings sometimes reach our ears

In the language of the ancients, as you know, the word Psyche meant both *a butterfly* and *the soul*. And in ancient art an association of the two ideas was embodied, in a figure of a beautiful damsel holding an expiring torch in one hand and a butterfly in the other. In this manner, the soul escaping from the worn-out body was portrayed. Christian writers have endeavored to improve upon their imagery, and in doing so have erred. They have compared man's earthly life to the caterpillar state of the insect, the tenantless body to the aurelia, and the future glorified body to the imago of the insect. In all this there is an evident straining of the analogy. The apostle St. Paul, to illustrate the great doctrine of the resurrection, said: "Thou fool that which thou sowest is not quickened except it die" (I Cor. XV, 36). But under normal conditions an insect does not die in the aurelia stage—death with it is the final scene—and so we never find the inspired writers making use of the metamorphoses of insects to illustrate that great doctrine.

One quotation from a modern writer will show at once, and better than a long argument, the inappropriateness of such illustrations. In the 2nd vol. of "Sermons for the Christian year" by the Rev. William H. Lewis, D.D., Rector of Christ Church, Watertown, Conn., page 312, we read:

> "We stand by the sedgy pond, and see dark forms of water-insects skating along, that could not live a moment if they were taken in that state out of the waves, just as we could not bear with such bodies as we now have the life of heaven; but by and by these insects" (appear?) "to sicken and die, and lie motionless for a while, and then a creature rises to the surface, climbs up some reed or flag, and dries itself awhile in the sun, and then flashes through the air, with the splendid wings of the dragon fly, perhaps. Nor could it live in its old home in the waters any more; just as man raised in his spiritual body will no longer be fitted for such life as he now lives on earth. It is an emblem of the resurrection—a creature of one world, or element, passing by decay and seeming death to another."

Unfortunately for this illustration, the nymph of the dragon-fly is both active and predaceous, and carries on its pursuits until the very hour in which it ascends the stem of a water-plant, or other prominence, from which, as from a vantage-ground, as soon as its outer skin is ruptured and cast off, the transformed body takes its flight to pursue its depredations in the upper air.

The illustration is a very unsavoury one. The Libellula is a terror to its neighbours in every stage of its existence; and surely the man who has "bulldozed" his fellow creatures in this world can hardly be warranted in indulging in blissful anticipations of doing the same in the world to come.

The giants among men of letters, the great masters of song and others, who in the strength of genius have trusted to their own observation, have sometimes, by a word, brought before us peculiarities of insect form or habit recognizable in all time. Thus Homer speaks of the *ringed* wasps; Shakespeare of the *mealy* wings of butterflies; Rogers of the glow-worm's *emerald* light; Shelley of the *golden* bee; Tennyson of the "*high-elbowed* grigs that leap in summer grass," Even Horace's "*mali* culices" strikes the musquito-bitten entomologist as singularly appropriate.

But lesser lights who have given rein to fancy, or have imperfectly interpreted the phenomena of nature, have often greatly blundered in treating on entomological subjects.

The entomological mistakes of writers have arisen:

(1) *From sheer ignorance.*—This was the case with the man who translated the pas

sage in the Greek Testament, which tells us that Herod was eaten of worms (*scholeches*, larvæ) and died,* by "He became a Skoletobrote, and died in the enjoyment of that office."

Such also, as regards Natural History, was the case with Bp. Oxenden, when on page 70 of "My First Year in Canada," he wrote:

"The little humming-bird is rather rare, and they are seldom seen but in gardens. They are more like butterflies or gad-flies than birds both as regards their size and habits."

From this slovenly statement we may fairly make this deduction: Since the humming-bird resembles, both in size and habits, the butterfly or the gad-fly, these insects in the same particulars and to the same extent, resemble one another. A somewhat startling entomological conclusion! A lady whom I know, having read the Bishop's book, still speaks of the ruby-throated humming bird as *the Canadian gad-fly*.

Bulwer Lytton makes a remarkable mistake from sheer ignorance of entomology. He describes one of his heroines as a lady of refined tastes, who kept living butterflies in her conservatory. *Some of these she allowed to escape after they had been confined for a year.* ("Kenelm Chillingley," Bk. V., ch. 5). The veriest tyro in entomology knows that the preservation of a living butterfly for a year would be miraculous. Lytton made a new departure in his statement. The usual tendency of authors has been to shorten the insect's life. Thus Mrs. Barbauld very elegantly says:

"Lo! the bright train their radiant wings unfold,
With silver fringed and freckled o'er with gold.
On the gay bosom of some fragrant flower,
They idly fluttering *live their little hour*,
Their life all pleasure and their task all play,
All spring their age, and sunshine all their day."

Another mistake frequently made in ignorance by authors is to portray the butterfly's life as one of unalloyed pleasure. Spenser says of the butterfly that—

—"evermore, with most varietie,
And change of sweetness (for all change is sweet),
He casts his glutton sense to satisfie
Now sucking of the sap of herbe most meet,
Or of the dew, which yet on them doth lie;
Now in the same bathing his tender feet,
And then he percheth on some branch thereby
To weather him, and his moyst wings to dry."

* * * * * * *

"What more felicitie can fall to creature,
Than to enjoy delight with libertie
And to be lord of all the works of Nature?
To reign in the aire from th' earth to highest skie,
To feed on flowers and weeds of glorious feature,
To take whatever thing doth please the eye?
Who rests not pleased with such happiness,
Well worthy he to taste of wretchedness."

Commenting on these lines, Leigh Hunt wisely says:

"After all, Spenser's picture of the butterfly's enjoyment is not complete entomologically. The luxury is perfect, but the reader is not sure that it is all proper butterfly luxury, and that the man does not mix with it. . . . "The butterfly perhaps is no fonder of 'bathing his feet,' than we should be to stick in a tub of treacle. And we ought to hear more of his antennæ, and feathers (for his wings are full of them), and the way in which they modify, or become affected by his enjoyments."—*The Indicator*, ch. LXIV.

The lines are beautiful, but the picture they present of insect delight is altogether overdrawn. St. Paul had a much better appreciation of things when he said, "The whole creation groaneth and travaileth in pain together until now," (Rom. viii., 22). We who have studied insect life can tell of the foes that beset it from its earliest stage to its final scene; the Proctotrypidæ that spoil the eggs; the Ichneumonidæ and Chalcididæ that assail the larvæ; the life-sapping fungi that destroy both larvæ and pupæ; *Phymata erosa* that lies in wait for the perfect insects in the very flower heads that attract them; the Dragon-flies, the Vespidæ, the Crabonidæ, that (as well as the insectivorous birds) pursue them in the upper air, all these form a terrible array of adversaries. Then there are to be borne the dark hours that curb their faculties, the rains that wash away their

*Kai genomenos skolekobrotos exephuxen.—Acts. XII, 23.

beauty, and the winds that wear and fray their wings. In the case of the Vanessidæ and Graptidæ there are the terrible torpidity into which the winter chills them, and what I imagine to be no less terrible, the partial awakenings on intervening milder days.

No greater contrast to the picture presented in the fine verses of Spenser can be shown to us than the *reality*, when in the early spring, a pair of hibernated Graptas—*Grapta Progne*, for example—perform their nuptials. Worn and dilapidated, the bloom and glory of youth swept away from them by winter storms, they furtively and in contradiction to the very name they bear (*Procne*, a swallow, one that shuns the woods), seek the shades and safeguards of the trees, whose lichens and mosses resemble in colour their own sober hues, and there unite themselves. The cycle of their existence is then soon completed, and they perish ere yet the summer has robed the world in beauty.

The judicious writer, whose comments on Spenser's lines I have quoted, says in the same chapter: "A year or two back"—his work was published in 1833—"everybody in London that had a voice was resolved upon being a butterfly born in a bower." When I was a boy the song to which he alludes was still popular, and the melody to which it was sung haunts me still. Copies of it have become scarce. When I was last in England I had great difficulty in finding one. This is how the words run:

"I'd be a butterfly born in a bower
Where roses and lilies and violets meet,
Roving for ever from flower to flower
And kissing all buds that are pretty and sweet,
I'd never languish for wealth or for power,
I'd never sigh to see slaves at my feet,
I'd be a butterfly born in a bower,
And kissing all buds that are pretty and sweet."

"What though you tell me each gay little rover
Shrinks from the blast of the first autumn day,
Surely 'tis better, when summer is over,
To die when all fair things are fading away.
Some in life's winter may toil to discover
Means of procuring a weary delay,
I'd be a butterfly living a rover,
Dying when fair things are fading away."

T. H. Bayley.

Epicurean, is it not? "Let us eat and drink for to-morrow we die." The sentiment is bad, and God, who has fitted all things in just proportions, never gave real ground for false sentiments. As we have seen, the butterfly is not a fit emblem of selfish frivolity. It bears the part in nature that it was destined to bear, and it has to endure its share of ills. Instead of dying when fair things are fading away, many species have to survive the winter, and to perish when fair things are bursting into life, and herein is a truer lesson for those who are aiming at what they are pleased to call a butterfly existence here.

Adelaide Taylor recognized the false sentiment in the song, and in one of those little rhyming lessons on propriety which she and her sisters composed for "infant minds," says,—

"The butterfly, an idle thing,
Nor honey makes, nor yet can sing,
Like to the bee and bird;
Nor does it, like the prudent ant,
Lay up the grain for time of want,
A wise and cautious hoard."

"My youth is but a summer's day,
Then, like the bee and ant, I'll lay
A store of learning by,
And though from flower to flower I rove,
My stock of wisdom I'll improve
Nor be a butterfly."

But in this little lesson we cannot help noticing another very common mistake, that of setting forth the ant as an example of acquisitiveness. Adelaide in the verses quoted suggests the acquisition of learning, but the example is generally taken to suggest the acquisition of wealth. Solomon's words are,—

"Go to the ant, thou sluggard, consider her ways and be wise:
"Which having no guide, overseer, or ruler,
"Provideth her meat in the summer, and gathereth food in the harvest."—*Prov.* VI., 6-8.

Now, the lesson conveyed in these words is only that conveyed in "Whatever thy hand

findeth to do, do it with thy might," or in "Be not slothful in business," or in the homely saying, "Make hay while the sun shines." There is nothing in them to countenance the hoarding propensities of the miser.

It has been supposed that Solomon referred to the *Atta barbara* of Palestine, which, like the *Atta malefaciens* of Texas, is said to store up grain However this may be, it is very certain that Adelaide Taylor had an English ant—*Formica rufa*, or one of its congeners—in view. Rev. J. G. Wood says,—

"Ants do not, as has been so frequently said, lay up stores of corn for the winter, for they are in a state of torpidity during the cold months, and require no food. Moreover, an ant would find as much difficulty in eating or digesting a grain of corn as we should in devouring a truss of straw."—Ill. Nat. Hist., p. 426.

Thomas Hood, however, in his "Ode on Autumn," goes to the full length of the mistake and says,—

"The ants have brimm'd their garners with ripe grain."

(2) *Many entomological mistakes of authors are found to be exaggerations of the truth.*

Whatever is strange in other lands becomes a "traveller's wonder." Stories of the admiration it excited in the beholders have afforded food for credulity and speculation. Of mistaken ideas the following Eastern Townships' story affords an instance. Two young Irish immigrants landed at Montreal some years ago. They travelled by the then new line to Waterloo, as far as Farnham. They walked from that place to Cowansville, and arrived at the hotel in the dusk of the evening. After supper they retired to their room. It was a hot July night and they threw open the window for air. In flocked the mosquitoes of course, and began to be very attentive to the new-comers. One of the lads, who was already in bed, called to his fellow, "Pat, put out the light and jump in, and then the omadhouns will not find us." Pat put out the light, but at that moment in sailed a fire-fly. "Och, Terry," he exclaimed, "its not a bit of use, one of the spalpeens *has been and got a lanthern.*"

Saint Pierre, the ingenious author of "Paul and Virginia," learned from Father du Tetre concerning *Pyrophorus noctilucus*, and says of it, in his "Studies of Nature," Vol. II., p. 299.

"There are insects which need no pharos to guide them in their nocturnal perigrinations. They carry their *lanterns* with them; such are the luminous flies."

Pietro Martire, in the "Decades of the New World," tells us that the lanterns of the fire-flies enable them to see the musquitos on the sleepers' noses, and to pick them off. (He says *faces*; but the whole includes the parts). His account is as follows:

"Hee who understandeth he hath these troublesome guestes (the gnattes) at home, diligently hunteth after the *Cucuij*. Whoso wanteth *Cucuij* goeth out of the house in the first twilight of the night, carrying a burning fire-brande in his hande, and ascendeth the next hillock that the *Cucuij* may see it, and he swingeth the fire-brande about calling Cucuius aloud, and beating the ayre, with often calling out *Cucuie, Cucuie.*" . . . . "The hunter having the hunting *Cucuij* returneth home, and, shutting the doore of the house, letteth the preye goe. The *Cucuij* loosed, swiftly flyeth about the whole house, seeking gnattes under their hanging bedds, *and about the faces of them that sleepe*, which the gnattes used to assayle: they seem to execute the office of watchmen, that such as are shut in may quietly rest. Another pleasant and profitable commodity proceedeth from the *Cucuij*. As many eyes as every *Cucuius* openeth, the hoste enjoyeth the light of so many candels; so that the inhabitants spinne, sewe, weave and dance by the light of the flying *Cucuij*."

The same writer tells us that the inhabitants travelling at night used to tie a fire-fly to each great toe.

Madam Meriam, the authoress of a History of the insects of Surinam, says that the light of the lantern-fly, *Fulgora lanternaria*, is sufficient to read by.

Now, all these stories are "travellers' wonders," and need to be taken *cum grano salis*. Dr. G. A. Perkins, in the *American Naturalist*, Vol. II., p 462, states that—

"By placing the luminous pads of one insect quite near the paper, very fine print can be easily read by its aid, though I cannot imagine the light, even of a large number, to be sufficient for any practical illuminating purposes, as has been affirmed by some writers."

But Southey, the Laureate, trusted to such particulars, and in "Madoc in Aztlan," Canto XVII., telling of Madoc's deliverance by Coatel, says :

"Fast along the forest way,
And fearfully, he followed to the chasm.
She beckon'd and decended, and drew out
From underneath her vest, a cage, or net,
It rather might be called, so fine the twigs
Which knit it, where, confined, two fire-flies gave
Their lustre. By that light did Madoc first
Behold the features of his lovely guide ;
And through the entrance of the cavern gloom,
He followed in full trust."

"Now have they reach'd
The abrupt descent ; there Coatel held forth
Her living lamp, and turning with a smile,
Sweet as good angels wear when they present
Their mortal charge before the Throne of Heaven,
She show'd where little Hoel slept below."

Robert Pollock, the author of the "History of Peter Wilkins," which is an entirely imaginative and unnatural work, may, perhaps, have read of the occasional phosphorescence of earth-worms. At any rate he makes the lighting up of the houses and streets of Arndrumstake to depend upon the supply of "Sweecoes," creatures which were bred by all the well-to-do persons in the community, for the sake of their light-giving properties. The lamps in which they were confined were globular, "like calabashes." The creatures were changed twice a day, and fed on leaves and grass.

Pollock enters into no minute descriptions of these creatures, and gives no particulars as to the breeding of them. He leaves all such things to the imagination of his readers ; and to it we also must leave them.

(3) Other entomological mistakes of authors have arisen from their launching from the known into the unknown.

It is a dangerous thing to give the fancy scope on subjects with which one is imperfectly acquainted.

Isaac Walton, in "The Complete Angler" (Fourth Day), gives a brief but accurate account of a larva of the Privet Hawk Moth (*Sphinx Ligustri*). The caterpillar died, "but if it had lived," says Walton, "it had doubtless turned to one of those flies that some call flies of prey, which those that walk by the rivers may, in summer, see fasten on smaller flies, and, I think, make them their food."

It is never safe to make guesses in Entomology. Charles Kingsley knew some things about the Dragon-flies ; but he made a *venture*, and—*he made a slip.* The redoubtable Tom of the "Water Babies" came face to face with an "ugly fellow" who informed him that he wanted to "split."

"Why do you want to split?" said Tom.

"Because my brothers and sisters have all split, and turned into beautiful creatures with wings : and I want to split too. Don't speak to me. I am sure I shall split. I will split!"

A wise resolution, I dare say ; but a little "too previous." However—

"Tom stood still, and watched him, and he swelled himself, and puffed, and stretched himself out stiff. At last, crack, puff, bang—he opened all down his back, and then up to the top of his head.

"And out of his inside came the most slender, elegant, soft creature, as soft and smooth as Tom : but very pale and weak, like a little child who has been ill a long time in a dark room. It moved its legs very feebly ; and looked about it half ashamed, like a girl when she goes for the first time into a ball-room ; and then it began walking slowly up a grass stem to the top of the water.

"Tom was so astonished that he never said a word ; but he stared with all his eyes. And he went up to the top of the water too, and peeped out to see what would happen.

"As the creature sat in the warm bright sun; a wonderful change came over it. It grew strong and firm ; the most lovely colours began to show on its body—blue and yellow and black spots, bars and rings ; out of its back rose four great wings of bright brown gauze ; and its eyes grew so large that they filled all its head, and shone like ten thousand diamonds.

"Oh, you beautiful creature!" said Tom ; and he put out his hand to catch it.

"But the thing whirred up into the air, and hung poised on its wings a moment, and then settled down again by Tom quite fearless.

"No!" it said, "you cannot catch me. I am a dragon-fly now, the king of all the flies."

—"*Water Babies*," Ch. III.

The mistake, of course, in all this is, that Kingsley makes the "splitting" to occur under water. Who ever saw, or heard of before, a dragon-fly bursting from its nymphal case below the surface? Why, it would drown! The nymph extracts oxygen from the water by means of a gill-like arrangement within the abdomen; the perfect insect breathes atmospheric air, through spiracles, as other imagos do. It is the nymph, or pupa, that performs the climbing—not the fly.

Wood, in his "Insects at Home," p. 273, says:

"When the pupa has nearly completed its time it ceases to feed, and the respiration seems difficult and labored. An irrepressible instinct then drives it to leave the water in which it has so long lived: and, seizing the stem of a reed or other aquatic plant, it crawls upwards until it is a foot or two above the surface: clasping the reed firmly with its feet, it sways itself backwards and forwards until the pupal skin splits along the shoulders and the wings and body of the perfect insect shows themselves beneath it," etc.

Mr. Spence, in Chapter XXV of "Kirby and Spence's Introduction to Entomology," points out a mistake made by the poet Darwin respecting the nut-curculio. Darwin's lines referred to are:

"So sleeps in silence the Curculio, shut
In the dark chamber of the cavern'd nut;
Erodes with ivory beak the vaulted shell,
And quits on filmy wings its narrow cell."

It is the maggot and not the beetle that quits the nut—its transformation takes place under ground; and the beak of the perfect insect would be better compared to ebony than ivory. In connection with these lines, Spence says:

"The gratification which the entomologist derives from seeing his favorite study adorned with the graces of poetry is seldom unalloyed with pain, arising from the inaccurate knowledge of the subject in the poet."

(4) *Other entomological mistakes of authors seem to have arisen from mere want of consideration of the balance of circumstances.*

Edgar Allen Poe, in one of his highly sensational tales, tells of "a gold bug." This bug, he informs us, was a scarabæus; but we are not to conclude that it was a right down honest "tumble-bug." The term scarabæus was formerly used for beetles generally. It may have been a sort of *Cotalpa*; but it had some peculiar qualities; ponderosity was one—it was so heavy that it was used as a plumb; but notwithstanding its great weight, it was very active—it flew on before. Then too its pugnacity was remarkably—it bit its captor's hand; and it was not without suspicion of exercising poisonous qualities like the centipede and the tarantula. *I need hardly say that the species has become extinct.*

I have no doubt that many other instances, such as I have adduced, of the entomological mistakes of authors could be found; but these will suffice for the presnt occasion. There is a satisfaction in turning the laugh against men of letters; for some of them have shown a disposition to under-estimate those benevolent, amiable and altogether-worthy gentlemen, who have been good enough to pursue the study of entomology for the benefit of mankind.

For example: Does Fennimore Cooper wish to portray an entomologist? He does so in Dr. Obed Batt; and the crowning scene in which this personage is presented is that in which he is brought forward by the Indians seated upon the *Vespertilio Horribilis Americanus* with his butterflies and other "specimens" disposed about his person—converting him into a sort of perambulating museum.

And yet Fennimore Cooper was considered a decent sort of man! I am told he was a church warden!!

But what shall we say of that horrible fellow Barham, the author of the Ingoldsby Legends, and of the fate that he awarded to an amiable scientific gentleman?

You have read, I dare say, of Vidius Pollio, who, in the days of one of the Cæsars, was accustomed to throw his aged and worn-out slaves into his fish-ponds to fatten his lampreys for the market. To such a fate does Barham devote an entomologist, "Sir Thomas." This good man, while searching for nymphæ, tumbles into the water and is

drowned. After a length of time (during which his widow is consoled by the attentions of one Captain McBride) he is fished out in a dilapidated condition ; and, from the pockets and other recesses of his clothing, a number of fat eels are taken. Some of these are cooked for the lady's supper. And this is what she says of them :

"Eels a many I've ate ; but any
So good ne'er tasted before !
They're a fish, too, of which I'm remarkably fond !
So pop Sir Thomas again in the pond —
Poor dear ! *He'll catch us some more.*"

The man, who could imagine such a termination to a useful and honorable career, ought to have been one of the crew of the "Nancy Brig," but *not* the 'long and weedy" survivor !

THE SEASON OF 1893.

By Rev. Thomas W. Fyles, F.L.S., South Quebec.

The season of 1893, though it opened somewhat later than usual, has been a favorable one for entomologists. Diurnals in the early part of it were particularly abundant.

My first capture of any kind was made on the 13th of April, when I captured a fine specimen of *Ufeus satyricus* Gr., in a window of the church at Rawdon, P. Que.

After this came a cold spell ; and *Chionobas Jutta*, Hub., which usually appears on the 1st of June, did not show itself till the 3rd. On this date I saw three specimens. On the 7th Mr. H. H. Lyman and I found it in perfection and in fair numbers. The improved drainage of the sourrounding properties is affecting the swamp at Bergerville in which this species is taken—it is not nearly so wet as it was in former years.

The first specimens of *Neonympha Eurytris*, Fabr. (Fig. 18) that—as far as my knowledge extends—have been captured in the vicinity of Quebec, were taken at St. David's by Mr. Hanham on July 1st. This species is not uncommon at Montreal.

Fig. 18.

Debis Portlandia, Fabr., appeared in this neighborhood in the 1st week of July and continued through the month. I have seen worn specimens of the species as late as the 2nd week of August.

Satyrus Nephele, Kirby, first showed itself on July 18th, and very dilapidated specimens of it were to be seen as late as August 31st.

Papilio Turnus, Linn. (Fig. 19) was remarkably plentiful early in the season. I had wondered in former years that it should be abundant at Quebec, seeing that so few apple-trees grow in the vicinity. The mystery was solved when I found the larvæ feeding on *Amelanchier Canadensis* which is abundant here.

Œdemasia concinna, A. & S. (Fig. 20) which in the Eastern Townships feeds upon the apple, feeds upon the bramble at Quebec. The larvæ in their early stages lie clustered on the under-side of the leaves, and thus escape notice. I found a batch of them on Aug. 5th and took them to my home, where I fed them alternately on bramble and apple. They fed with avidity upon both and throve equally upon them. They attained their growth (Fig. 21) and went into cocoon among dead leaves on the surface of the earth.

Another apple-tree feeder that has to change its diet at Quebec is *Platysamia Cecropia*, Linn. It feeds on the soft maple (*Acer rubrum*) and also, I am inclined to think, on the alder. Last autumn I found two cocoons (Fig. 22) of the species in the midst of an alder swamp, far from tree or shrub of any other sort.

In the Society's 23rd Report I recorded my first captures, on the Heights of Levis, of *Colias interior*, Scud. They were made in the month of September. This year I watched carefully for the appearance of a summer brood. It came in July. I took one or two specimens at St. David's on the 1st of the month, and on the 6th the insect was out in increased numbers. It was gone by the end of the month. As I have said the autumn brood of Interior appears in September.

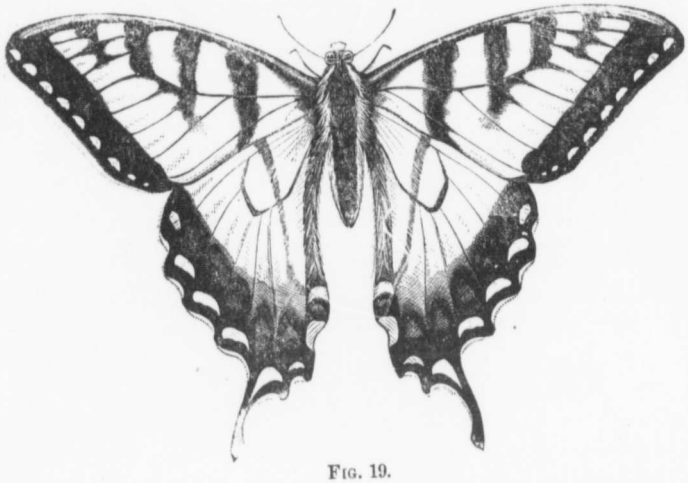

FIG. 19.

FIG. 20.

FIG. 21.

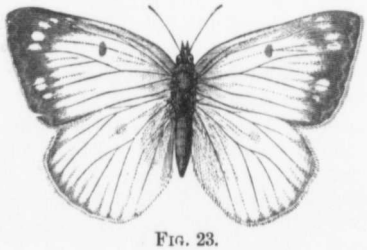

FIG. 23.

FIG. 22.

In the last week of July a second brood of *Colias Philodice*, Godt. (Fig 23.) appeared. It was out in abundance by the 1st of August. On the 31st of that month worn females were still to be seen laying their eggs on *Vicia cracca*. On the 2nd of October I captured fresh specimens of a third brood of Philodice; and on the 22nd of that month this species was still plentiful, flitting about the flower-heads of Taraxacum.

Argynnis Cybele, Fabr., *Argynnis Aphrodite*, Fabr., and *Argynnis Atlantis* Edw., appear in July. On the 6th of the month they were all on the wing together. I found a full-grown larva of the first named on June 18th. It went into chrysalis on the 20th, and the imago appeared on July 9th. For the escape of this the pupa case was ruptured *on the under side*—the upper remaining intact. On the 31st of August very worn specimens of Atlantis were still on the wing.

Melitœa Harrisii, Scud., was plentiful at Levis, this year at the end of June. It continued till the 2nd week in July. A few years ago I took this species at St. Henri, 9 miles south from Levis. It frequents spots in which its food-plant, *Diplopappus umbellatus*, is abundant.

Limenitis Arthemis, Drury, was rather plentiful from the 1st of July till the middle of the month.

Two of the prizes of the season were taken by Mr. Hanham on the Island of Orleans, viz:

Anisota senatoria, Guen, and *Plusia thyatiroides*, Guen. Thanks to the generosity of Mr. Hanham the former is now in my collection. I have only heard of one previous capture of this insect in the Province of Quebec. It was made some years ago by the late Mr. Bowles.

Other captures worth recording were *Feniseca Tarquinius*, Fabr., Aug. 14th, Isle of Orleans. *Grapta gracilis*, Gr. & R, July 17th, Levis. *Vanessa Milberti*, Godt., July 3rd, Isle of Orleans. *Pyrameis Huntera*, Drury, Aug. 5th, Isle of Orleans. *Hemaris tenuis*, Gr., Aug. 5th, Isle of Orleans.

The season has been a fine one for the "Skippers." The order in which the different kinds of these appeared at Quebec was as follows:

The first to show itself was *Pamphila Zabulon*, Bd.—Lec. It came early in June. While it was still out *Pamphila Taumus* appeared in crowds dodging about the meadows like children "playing tag."

Pamphila Mystic, Edw., presented itself on the 1st of July and continued till the 20th. On the former date Mr. Hanham took a worn specimen of *Carterocephalus Mandan*, Edw., at St. David's, on the south side of the St. Lawrence; and on the 9th of the same month he captured at the same place a specimen of *Amblyscirtes Samoset*, Scud. Both Mandan and Samoset are very rare at Quebec, two or three specimens only of each kind having, to my knowledge, been taken. On the 11th of July *Pamphila Wamsutta*, Harr., and *Pamphila Metacomet*, Harr., showed themselves. At this date Taumus was still plentiful.

Pamphila Manitoba, Scudder, appeared on the 5th of August and continued till the 25th. It was plentiful on the Island of Orleans and on the Heights of Levis (see 23rd Rep., p. 31) frequenting the flower-heads of Solidago and Gnaphalium. On the 10th of the month and again on the 13th I obtained eggs of the species. They were laid dispersedly on blades of grass, etc. Their size (nearly one-twentieth of an inch in diameter at the base) was large in comparison with that of the mother insect. Their shape was that of a gum-drop—flat at the bottom and rounded above. They were white like frosting and in some lights seemed to be irrorated with red, blue and green. *They have not yet hatched.*

An insect which has been very abundant in this locality this season is *Depressaria Heracleana*, De Geer. The species was well and fully described by Dr. Bethune in the *Canadian Entomologist*, vol. II, page 1. In this district it feeds in the umbels of the Cow Parsnip, *Heracleum lanatum*, and, when full fed, bites its way into the hollow-stems of the plant and spins its cocoons in their recesses. The moths come out in the Fall and hibernate.

The Wild Hazel, *Corylus Americanus*, has this year been much infested with the larvæ of a species of Lithocolletis—probably *L. Coryliella*, Chambers. These creatures form circular blisters, about the size of dimes, in the leaves of the plant. In appearance they somewhat resemble the larvæ of *L. hamadryadella* as shown in an article by Prof. Saunders, in the Report of the Fruit-Growers' Association of Ontario for 1882, p. 277. They are about three-tenths of an inch in length, much flattened and having the segments very distinctly marked. In colour they vary from sage-green to amber. The head is small and flat. From the 3rd to the 11th segments inclusive, there are, on the under side, remarkable elongated, brown markings; and on either side of each segment, from the 6th to the 11th inclusive, there is a round, brown spot. The feet are white and are merely warty projections. Along the sides are a few slight bristles. The larvæ have not yet gone into chrysalis but have become more plump and of a lighter tint of amber.

Perhaps the most note-worthy occurrence of the year, from an entomological point of view, has been the amazing numbers of the larvæ of *Catastega aceriella*, Clemens. From Montreal to Quebec and southward to the border they have appeared in myriads. Every maple-leaf seemed to have its tenant.

The operations of the Catastega larva are very remarkable. Working on the under side it gathers around itself a considerable portion of the leaf, securing the lines of contact of the gathered part with a web. Then it bites away portions of the inner skin of the leaf and proceeds to make itself a case; and, as it grows, it enlarges this till it is about an inch and a half long and in shape something like that of a cornucopia. Into this it can completely retire. The larva when full grown is about half-an-inch long, cylindrical, pale green, with an amber-colored head. It attains its growth about the time that the leaves begin to fall. It then vacates its case and spins a slight cocoon between the leaves or in the folds of a leaf. The pupa is about one-fourth of an inch long, pale yellowish brown in colour, having rather large wing cases and tapering abdominally to a point.

The insect was named by Clemens who mentions it in the Proceedings of the Ent. Soc. of Phil., vol. I (1861), p. 87. He seems to have been acquainted with the case only. There is a reference to the insect in Packard's Forest Insects, p. 409. We shall probably know more about the insect next spring when the imagos begin to appear.

In the meantime, the way to check the increase of the species is obviously to rake up the dead maple-leaves into small piles, and—under favorable circumstances—to burn them.

On August the 23rd, a curious phenomenon was witnessed in Quebec. All the streets of Lower Town were occupied with clouds of winged ants, of the species *Formica flava*, Fabr. The carters had the utmost difficulty in controlling their horses; and the foot-passengers shrouded their faces as they walked along. I read in the papers at the time that a similar plague had appeared in one or two places in the Maritime Provinces.

The Lombardy Poplars in these parts were, this season, affected by a species Pemphigus. The insect produced galls on the leaf-stalks, resembling in size and shape the nut-galls of commerce, and having on one side a slit about three-sixteenths of an inch long. I opened one of the galls on the 6th of July, and found it to be full of insects of the kind, some winged and some wingless. After the galls had withered, I found numbers of apparently the same species of insect, in the wingless state, infesting the young willows near by. The creatures lay thick on the under sides of the twigs sucking the plant-juices.

My last captures this year were made on the 4th of October, when I took *Therina fervidaria*, Hubn. and *Epirrita dilutata*, Bork,* as they were resting on the trunks of trees at Spruce Cliff, Levis. On the same day I saw a fresh female of *Orgyia antiqua*, Linn, laying her eggs on a young spruce.

E. dilutata was taken at London, Ontario, about the same time, by Mr. J. Alston Moffatt.

T.W.F.

MOSQUITOES.

By J. Alston Moffat, London, Ont.

The mosquitoes belongs to the order "Diptera," or two-winged flies, which includes all insects of whatever size, form or color, which have but two wings, making them easily separable from the Hymenoptera, to which the bees and wasps belong, which are possessed of four wings.

Again, the mosquitoes belong in that order to the family Culicidae which are characterized by long and slender mouth parts, long legs and antennæ, of which there are many genera, and the genus to which the mosquito belongs is called Culex, which is recognizable from the other genera of the family by its biting propensity, whilst the distinguishing, or specific name of our common form, is Pipiens of Linnaeus; a name suggested by the constant piping produced during its flight by the rapid stroke of its narrow wings which are said to vibrate three thousand times a minute. (Fig. 24) represents a mosquito, and (Fig. 25) its mouth-parts highly magnified.

A large number of species have been described and named by different authors—30 are given to Amercia, 35 to Europe and 100 to the rest of the world.

Mr. F. W. Urich, in a paper read before the Trinidad Field Naturalist's Club, says: "So far as Trinidad is concerned I may say I have observed at least ten different kinds of mosquitoes, varying in size and color, and the bite of some of them is far from being pleasant." But as in other departments of natural history, species have been created upon very slight differences, the probability is that many of those so-called "species" are

Fig. 24.

Fig. 25.

but local variations of one species. Yet certain it is, very considerable difference in size is to be observed in the same locality, but as all creatures are given to vary in size, the same liberty may be allowed to Culex pipiens. Whether the bite of the large ones is severer than that of the small ones, does not seem to have been specially observed, but personal experience corroborates the statement that all bites are not equally sharp.

The name Mosquito is a Spanish term, signifying "little fly," and would probably be applied to any biting winged insect, regardless of structure, by the Spaniards who first landed on the continent. And those of them that returned to their own country would relate stories of suffering they had to encounter and endure from their tiny foes; which were of more than Aztec ferocity and tenacity. Even yet extraordinary tales are told of the size and savage nature of the mosquitoes of some localities over those of others. The fame of the New Jersey breed and the Mississippi gallinipper has gone far abroad, but I suspect that the principle cause of suffering in one locality over another, is to be attributed to numbers, rather than to any difference in the size of the insects. Travellers have recorded their experience with mosquitoes in all parts of the world; some declaring that those of the Artic regions are the worst they ever encountered, but South America, from its climatic conditions, and its low-lying lands, which are frequently flooded, is in a position to carry off the prize against the world for its crop of mosquitoes, and that the early travellers there were duly impressed with this fact is evidenced by the names given to

places such as the Mosquito Coast, Mosquito Bay and Mosquito Town. In ancient history we read of armies on the march being arrested on the way and made to beat a hasty retreat from the attack of these tiny warriors, which is quite believeable; for if we take into consideration the scant and loose covering which they probably wore, which gave the wearers so much more space to defend, they were not in a condition to pursue human foes when every man of them was engaged in a double-handed conflict with such pertinacious insect enemies.

There is a prevalent opinion in Europe that mosquitoes are an exclusively American production, and in England especially it is the general belief. We often see it in print and hear it confidently asserted that there are no mosquitoes in England. The usual expression is "We have gnats but no mosquitoes," whilst the fact is, the English Gnat and the American Mosquito cannot be separated generically and probably not even specifically. The two names being but local synonyms for the same insect. But even scientific authorities have assisted in perpetuating the misunderstanding. Newman in his "Familiar introduction to the history of insects," has a paragraph headed "Mosquitoes or Simulites," in which he refers to a wood-cut of a Simulia, which strongly resembles that terrible pest to the early settlers of the country, the "Black Fly," *Simulium molestum*, whilst he gives Gnat as the common name for the genus *Culex*.

The settlers of this country adopted the common name Mosquito for *Culex pipiens*, and used the name Gnat to designate an insect that was more felt than seen. So microscopic was it, that the excessive irritation produced by its attack on exposed parts was often the first intimation of its presence; yet so abundant were they at times, that small clouds of them were distinctly visible from their density. They were active only in the evening, or in densely shaded woods. This pest seems to have entirely disappeared with the clearing up of the country.

Many people call all mosquito-like insects by that name, or, if in Europe, they would call them gnats, and include under these names, the families *Tipulidae* and *Ephemeridae*, which are quite innocent of all biting propensity. So that when these names are used and alarming reports circulated as to their abundance, it is impossible to be quite sure what insect may be meant. It is recorded that in 1736, gnats were so numerous in England, that vast columns of them rose in the air from the spire of Salisbury Cathederal, like smoke, which made the people think it was on fire. Mention is made of a column, pyramidal in form, over a tree, 50 or 60 feet in height (?)—whilst, at a more recent date, another column is mentioned as being seen in a garden 3 feet in diameter and 20 feet high. We may justly conclude that these columns were not composed of *Culex pipiens*. And when we are informed that "every part of these columns was in the liveliest motion," we may at once infer that they were composed of some of the *Ephemeridae*, which Wordsworth alludes to, as

> "The gilded summer flies,
> That mix and weave their sports together in the solar beam."

And when we are told that "their bite was so envenomed that it was attended with violent and alarming inflammation," we may safely say, that these bites did not belong to those columns, but to the genus culex, whose habits are quite different. Who ever saw *Culex pipiens* in a playful mood? She is ever intensely absorbed in business, even her song seems to indicate that her thoughts are bent in that direction; at least it turns ours very quickly to her business methods.

Whilst on the subject of these dancing columns, I will give an illustration of their remarkable powers of sustained flight, which came under my own observation. I was returning from an excursion by rail, on a fine summer evening, and to have an opportunity of enjoying it to the utmost, I took my seat on an open car which had been fitted up to provide extra accommodation. The car in front of me was high roofed, and over a rear corner of it had gathered one of these clusters, high and dense, which was vigorously besporting itself in the rays of the setting sun. I thought to myself "when we go, you will get left," but I was mistaken. When the train started it went with it, and the cluster maintained its position with as much apparent ease as when the car was at rest. Did

each individual of that cluster keep its eye on the car, so as not to fall behind? But it could not accommodate its movements to suit the lateral swaying of the car; every now and again it found itself a little more off or on the corner. It maintained its position until darkness obscured or dispersed the dancers.

Culex pipiens, like many of its relations, lives the earlier part of its life in the water. The female mosquito when ready to deposit her eggs, seeks for stagnant water as the most suitable place on which to do so. The Rev. J. G. Wood thus clearly describes the opperation: "Placing her front legs on a picce of floating stick, straw, or anything that will support her tiny weight, she allows the middle pair of legs to rest on the surface of the water, and crosses the hind pair so as to look like the capital letter X. She then deposits a rather long and spindle-shaped egg, and places it upright with the base downward in the angle of the X. Another egg is quickly placed by the side of the first, and followed by others, all of which are glued together by a cement which is not affected by water. Guided by the crossed legs, the eggs are formed into a boat-like shape, and are left to float on the surface of the water."

These boat-like masses are often longer than wide, the lower end of the eggs being the largest, where the head of the future larva is to be, gives more surface below than above, which naturally turns the ends upwards and helps to give them the boat-like form. In a few days time, according to the weather, the eggs mature and the tiny larva is ushered into what is for the time its native element. In this state it is a particularly interesting creature, large in head, slender in body with two openings at the tail; one situated a little to one side, and surrounded with fine hairs, opens into the breathing tubes, the other being the end of the digestive canal. It is very active, propelling itself through the water with a peculiar jerking and wriggling movement, which has procured for it the appellative "wriggler," going to the bottom to feed, then rising to the surface to breathe. It may at times be seen resting with its breathing tube above the surface, head down and its mouth-parts moving as if it was taking nourishment. Having changed its skin several times, and eaten all it wants, it prepares for another change of form, and throwing aside its larval covering, it emerges a pupa. Its form is greatly altered, much larger at the head end where the mouth-parts, wings and legs of the future mosquito are bunched together in a rudimentary state, the abdomen slender with two propeller-like blades at the end to assist its movements, for it is still active, but more singular still for a pupa, it breathes now not through a tube at the tail as fomerly, but through two projections which it has been provided with, which are situated on the top of the thorax, so that when it rises to the surface of the water to breathe, it holds its head up now. A wonderful change of habit in so short a time; whilst living in this state, it also enlarges but does not feed. Having thoroughly matured it is now ready to change its aquatic life for an aerial one. The pupa comes to the surface of the water, the thorax rising above it, the hinder part straightens out, and almost immediately the pupa case bursts on the top of the thorax, and the head of the mosquito appears in the opening by a contracting and expanding of the abdomenal segments, the head and thorax are pushed forward and out sufficiently far to free its legs, when it feels for a support which may be the pupa-case which now floats on the water as a boat. The wings now expand, the abdomen is withdrawn from the case, and *Culex pipiens* is off on other business. The whole time required for this last transformation is a minute or less. The length of its preparatory life is variously estimated, the weather having a powerful influence—a month is considered quite sufficient. Three or four days to mature the eggs, fourteen or eighteen for the larval stage, and five to seven for the pupal. But Prof. Riley, says: "Their delevopment is rapid and with one species at least it has been ascertained that the entire life-round from egg to adult is undergone in less than two weeks."

As soon as they have got their wings they make for the thickest vegetable shade within reach. It is said that they will fly for miles inland, but never fly far over water. We read of travellers on the South American rivers, that they prefer to pass the night in their small boats anchored out on the river, rather than attempt to sleep on shore; willing to run the risk of being devoured by alligators in order to escape the certainty of it by mosquitoes.

Culex pipiens is a frail and delicate creature to be possessed of such a vicious and blood-thirsty disposition. But here it must be stated that the sexes differ in this respect. It is the female only that bites; she alone is responsible for all the evil reputation which has been attached to the species; the male has not the power, even if he had the will, whilst her will and power seem to be commensurate.

The mouth parts of the female constitute a wondrously elaborate and complex apparatus, which no verbal description can do justice to. What appears to the naked eye to be a single sting, is composed of no less than seven distinct and separable parts. What is taken for the sting is only the sheath in which the sting rests when not in use. Two of the parts are barbed at the point for cutting the skin. All but the sheath enter two-thirds their full length before they begin drawing the blood, the sheath doubling up under the body of the insect.

The manner in which the mosquito draws up the blood to satisfy its cravings, is probably similar to that by which a butterfly secures the nectar from the flowers. Let us consider the long proboscis as lips, the mouth proper being situated in the head at their base; when the lips have entered the fluid the muscles around the mouth are contracted; that produces a cavity which is necessarily a vacuum, the fluid naturally rushes in to fill it. When it is filled the muscles around the mouth relax, a valve at the base of the lips closes and prevents its return, and the fluid is forced down the gullet.

The rapidity with which the mosquito thus pumps up the blood, and the quantity it secures in a given time, may easily be observed by any one curious to know, by allowing one of them to operate on the back of the hand, and watch the filling up of the abdomen. I once clipped the end off the abdomen of one thus situated without disturbing its operation, and it pumped away until a pool of blood that had run through it formed on the back of my hand and began to run off, when I stopped the performance. I had been informed that this could be done before I succeeded in doing it.

No poison gland has yet been found in the mosquito, but the irritation resulting, and often continuing long after the bite is given, has led to the general conviction that poison must be conveyed with it. One writer relates that a drop of clear fluid has been observed at the end of the trunk, whilst Reamur says he saw fluid in the trunk itself. Some contend that this fluid is used for diluting the blood so as to enable it to pass through the extremely fine tube, but the quantity that they produce is so small, as compared with the amount of blood they take, that it could have but little effect in that way; unless it was endowed with some powerful chemical property. Some have stated that if they are allowed to take all they want, there will be no after irritation, the poison being all removed with the blood taken. But personal experiments in this direction do not confirm the statement.

There is a great diversity in the effect of the mosquito bite on different persons, just as there is in the sting of a bee; not from any difference in the sting and bite, but from something in the constitution of the individual. The Rev. J. G. Wood tells us of the effect of a single gnat bite on himself, given at the junction of the thumb with the wrist. (It is *culex pipiens* he is speaking of). He says: "The hand swelled up until it looked like a boxing glove, was purple in color where it was not crimson, and it was more than three weeks after the bite was inflicted before I fully recovered the use of my hand." This may be considered a serious case, and if he had received several bites at the same time, some of them about the face, we shall say, there is no saying how much more serious it might have been. I copy the following from a communication by H. Stewart, of North Carolina, dated Nov. 3, 1891, given in *Insect Life*, Vol. 4, p. 277, as illustrative of this point:

"I was interested in reading a recent number of *Insect Life* to the effect that the poison of the mosquito was provocative of insanity. When I was engaged in exploring in the vicinity of the north shore of Lake Superior about twenty-five years ago, I had more than one proof of this fact. One of my men was badly bitten, and seemed to suffer more than any others of the company. He became violently insane and ran off in the woods, and in spite of efforts he eluded pursuit and was never found again. Another man on a different occasion was affected in a similar manner, and was captured with difficulty, after a long chase, in which he exhibited the utmost terror, but after a few days' close confinement in the camp he regained his reason. Afterwards he was so seriously

affected by the poison that he had to be sent home. I have noticed that the poison affected persons differently, causing severe swelling in some, fever in others, pains in the limbs in others, while some were but slightly annoyed. I was myself very little troubled by these pests" Along with that we may place the report given by a German professor, of a Mexican doctor who was attending a lady suffering from inflammation of the brain. She had been unconscious for twelve hours, and gave signs of approaching dissolution. The doctor removed the mosquito net and opened the windows, giving the mosquitoes free access to his patient for two hours, when consciousness returned and the lady given up for lost started on the way to recovery, which is quite a likely thing, as blood-letting would be an excellent method for relieving the congested parts.

We frequently read in the newspapers of people suffering from alarming sores, the result of "a mosquito bite," some of them ending fatally. Thoughtless persons, or those ignorant of the nature of mosquito bites, will persist in rubbing the bitten parts, which only tends to increase the irritation and calls for more rubbing. This, continued, may break the skin, blood-poisoning may then ensue, and, if combined with an unhealthy condition of the system, death may quite likely be the result. I have seen children whose bodies were covered with sores caused by their scratching the mosquito bites.

To those who have not lived in a mosquito infested-district, and have formed their opinions by reading such reports; it might seem to them that life in such a place would be constant misery, and would expect to find the inhabitants covered with sores and bandages; but such is not the case. There is unquestionably a kind of inoculation that takes place in those much exposed to the attack, which gives them immunity from any inconvenience after the bite is given. The writer of the article "Mosquito," in the *Encyclopædia Britannica*, says: "Even in Britain the annoyances caused by the gnats—"*culex pipiens*"—is very great, and in marshy districts often unendurable, especially to new comers, for it seems probable that the insects really attack a visitor more furiously than they do the natives of the district, but, on the other hand, the latter may be more indifferent to their assaults." Now, we cannot suppose that the mosquitoes prefer a stranger to a native, or that the native does not feel the bite. It is the consequences that make the difference; the visitor dreads these, the native does not, as there are none to him, he having been thoroughly inoculated; the bites may be felt equally by both, although there are some endowed with a greater amount of pachydermatous insensibility than others. It is undoubtedly new-comers to an affected district that suffer the worst, that is, if they have not previously been subjected to the attack. Usually a bite on such a one raises a spot about the diameter of half a pea, hard and whiter than the rest of the skin, with a distinct red dot in the centre, producing an immense desire to rub the spot, which, if indulged, causes various degrees of inflammation and redness, with an increased inclination to rub, lasting for two or three hours with some, but twenty-four or more with others. This sort of thing may have to be endured for the whole of the first summer. After that the bite may be felt just as sharp as before, but no such after discomfort will follow. Hence the apparent indifference of the native, but sufficient numbers would make even him quail before their assault, but, being once clear of them, no further inconvenience is felt by him. This kind of inoculation is vividly illustrated in the case of children going into an infested locality to live; for the first season every bite leaves its mark conspicuous, but afterwards bites show no more than if they had not been given.

How long the mosquito lives in the mature state, is not known with any degree of certainty. Dr. C. V. Riley says: "So far as we know, our northern mosquitoes pass the winter in the imago state, but in limited numbers." Supposing these hibernators are the parents of the summer crop, they might in this latitude begin depositing their eggs—of which they lay about 300—in the beginning of May, and allowing a month between egg and imago, we see that by midsummer the number, under favorable circumstances, would be great. But the question to settle is, how long does the female live in summer before depositing her eggs? for we cannot suppose that, contrary to the nature of other insects she lives long afterwards; unless she does not lay them all at once. When one visits a piece of woods situated a long way from stagnant water every few days, and finds an un-

limited supply kept up for weeks, or even months together, it does not seem to favor an early demise. Another interesting question in this connection is, are these hibernating females fertilized before winter sets in, or do the males live over also?

It is the prevailing opinion that mosquitoes live exclusively on animal blood, and yet, probably, not one in a million of them ever gets a taste of it. It is not reasonable to suppose that the life, even of the mosquito, can be sustained long without food of some sort. Several reports have been made from time to time of a vegetable-feeding species of mosquito having been seen. Is it a separate species, or is it our old acquaintance *Culex pipiens* indulging in a little of her natural vegetable diet? I once saw a mosquito on the smooth bark of an aspen poplar, seemingly engaged in an effort to extract something out of it, but with very limited success, so far as the appearance of the abdomen indicated, yet it went through all the movements required to make the success complete. If they will attack the hard bark of a tree, how much more likely is it that they would try the soft stems of succulent plants. When we understand that this is one of the habits of the insect, we see that there is a double reason present why they should seek the cover of rank vegetation, one protection from the direct rays of the sun, which they cannot endure; the other, that they may obtain food to sustain life, Yet, no matter what amount of vegetable juice they may take, it never slacks their thirst for blood. This the unfortunate collector well knows to his cost, when he has been allured in the pursuit of some attractive specimens, to the stirring up of a tall and luxuriant clump of weeds in a damp and shady place.

Many remedies have been suggested for relieving the irritation produced by mosquito bites. The Rev. Mr. Wood says arnica saved him from a vast amount of torture. A wash of ammonia is said by others to give immediate relief.

To rid the house of their presence in the evening, so as to get peaceful rest at night, all are familiar either by observation or report, with the use of smoke. Indeed, the primitive "Smudge" was the only method available in new settlements; but now we have a more clean, convenient and efficacious material to use for the same purpose in insect-powder, 'pyrethrum." Make a little pyramid of the powder about an inch an a half in diameter at the base, on some incombustible material, and ignite it at the top. It will consume slowly, producing smoke enough to fill a large room, which will kill or stupify every mosquito in it.

I copy the following from *Insect Life*, Vol. V., p. 359.: "The *Indian Medical Journal* for March 16th says that a Bombay newspaper calls attention to the virtues of the castor oil plant as a means of protection against mosquitoes. In Egypt it is planted about houses to drive the insects away. In towns a better plan is to have the growing plants in pots, and bring them into the house for a day or two at a time, but they must not be kept too long in the shade, for *Palma Christi* is a sun-loving plant. A writer is cited as saying that the mosquitoes are killed by a poison they find on the lower side of the leaf, but it is stated that if a dozen leaves are placed about a room that swarms with mosquitoes they will disappear without leaving any dead ones lying about." But vigorous efforts should be made in all mosquito-infested localities to reduce as much as possible the opportunity for their breeding. Stagnant water is well-known to be the principle source whence comes the mosquito plague. This, then, should be got rid of as soon as possible. When this cannot be done at once it should be treated with a little coal oil, which will put an effectual stop to their propagation as has been demonstrated by Mr. L. O. Howard's experiment, published in the last Annual Report of the Society, and thus an immense amount of suffering will be saved to man and beast.

CANADIAN UROCERIDÆ

(Abstract of a Paper presented to the Royal Society of Canada.)

By W. Hague Harrington, Ottawa.

The paper which I have the honour to submit is, from its length and the number of descriptions contained in it, not suitable to be read in full. I have, therefore, made a short abstract from its contents, to indicate its scope and purposes. It treats of the Uroceridæ, a family of the order Hymenoptera; the species of which are lignivorous in the larval state and attack our forest, shade and fruit trees.

In discussing these insects I have accepted the name Uroceridæ in accordance with the classification of North American Hymenoptera published by Mr. E. T. Cresson, who for many years has been a diligent student of the order, and who has described a large proportion of the American species. In agreement with European nomenclature, the name Siricidæ would be used, as the first species described were placed by Linnæus in Sirex, one of the ten genera into which he divided all the Hymenoptera. His simple classification has been so expanded, to receive the vast number of insects since described, that the Hymenoptera of America, north of Mexico, are separated into about a thousand genera.

The genera placed by Cresson in the family Uroceridæ have been the subject of much discussion by systematic entomologists and their relations to one another and to the Tenthredinidæ, have been variously viewed. The object of this paper is not however, to discuss the systematic position of the genera, but to bring together for the benefit of students of the Canadian fauna, the descriptions of the various species, and to add such information regarding them as my observations have furnished. No new species are described, but I have rather endeavored to show where the present number of species could be lessened, and the suppressed be placed as varieties. The insects of this family vary very much in size and sometimes in coloration, and several of the species being widely distributed and rare, have been redescribed from different regions.

There are five genera: Cephus, Xiphydria, Urocerus, Tremex and Oryssus. To facilitate the identification of specimens, I have prepared synoptic tables based upon such features as seem most distinctive. The individuals of Cephus appear to be very rare in Canada, but six species are represented, including *C. pygmæus*, Linn., which has been introduced from Europe, where it is well known, and at times a destructive borer in the stems of wheat. In Xiphydria several species have been described, but some are only varieties. The most common species is *X. albicornis*, Harris, which is frequently found on maples, and which does considerable injury to shade trees. I have given observations upon its habits, in the publications of the Entomological Society of Ontario.

The typical genus Urocerus (Sirex) contains about twenty American species of which nearly all occur in Canada. Some of these are large, handsome insects, widely distributed throughout the Dominion; from Nova Scotia to Vancouver Island and very far northward. The larvæ of these insects are borers in our coniferous trees and their distribution is probably co-extensive with the trees they infest. In some sections, pine, spruce, fir, etc., suffer considerably from their attacks. The three most common species are *U. albicornis*, black, with white banded legs and antennæ; *U. flavicornis*, black, with yellow bands and antennæ, and *U. cyaneus*, blue, with ferruginous legs.

Tremex contains only one species, the well-known *T. columba*, the larvæ of which are popularly known as Horn-tails, a name also applied sometimes to the adult insects on account of their long ovipositors. This insect attacks chiefly the maple and beech, which are often thoroughly riddled by its larvæ, but it also infests other forest trees, such as oak and sycamore, and fruit-trees, as apple and pear. It is a striking insect in appearance; one of the largest of our Hymenoptera; richly marked with black and yellow, and provided with a long, stout ovipositor for penetrating the thick bark of the trees in which it deposits its eggs.

The genus Oryssus differs in many important characters from the preceding, and the insects have a very different appearance. They are short and cylindrical in form; black, or with the abdomen partially red; have the antennæ short and geniculated, and in their movements they are extremely alert and active. Four species have been on the American lists, but observations which I have made on these insects for several years have convinced me that they all belong to one species. The larvæ live in maples (and possibly in other trees) but it is not known whether they live upon the substance of the tree, or are parasitic upon other wood-boring insects.

For a satisfactory knowledge of the habits of our Uroceridæ, it will be necessary for our entomologists to devote much close attention to the several species. Unfortunately the order Hymenoptera has not at present many students, although both from the scientific and economic standpoints there are many reasons why it should be thoroughly investigated. The late Abbé Provancher, whose scientific labors, especially in Entomology, gained for him a membership, which, unhappily he did not long live to enjoy, in your honorable Society, was a zealous worker in this Order, and he described very many of the Canadian species. His death was a great loss to the study of Entomology in Canada, but it is to be hoped that his collections, which contain the types of so many species, may be placed where they will be carefully preserved and accessible to future investigators.

ADDITIONAL NOTES ON JAPANESE INSECTS.

By W. Hague Harrington, Ottawa.

On my return in November, 1891, from a visit to Japan, I prepared for the annual meeting, held a few days later, a hasty outline of my impressions of the insect fauna of that country. My captures have since been mounted and arranged, and the number of genera and species ascertained, although time has not yet been found to determine the names of the insects. My stay in Japan lasted only ten weeks, and this time was largely occupied in travelling and sightseeing, so that I had few opportunities for systematic collecting, and many of my most interesting specimens were accidental captures. The wealth of the insect fauna is evident, from the fact that under such conditions, and after the most prolific season had passed, six hundred species were taken, Coleoptera constituting one half, Hymenoptera one-fourth, and miscellaneous insects the remaining fourth. The majority of the specimens were obtained in the vicinity of Yokohama, Hakone and Nikko, which are all situated in the central portion of the Empire. Adding to my own captures some Coleoptera received from my brothers residing in Yokohama, I find my little collection to be composed as follows:

Coleoptera	350	Species.
Hymenoptera	160	"
Hemiptera	75	"
Diptera	30	"
Orthoptera	20	"
Lepidoptera	10	"
Neuroptera	10	"
Total	655	

The last four orders are too scantily represented to be compared with those of our fauna, and even the Hemiptera are scarcely numerous enough to afford a basis of comparison.

The Coleoptera and Hymenoptera, however, seem to warrant a few remarks, as a supplement to my former very imperfect paper, and I have therefore prepared tables showing the number of genera and species in the families represented in these orders.

COLEOPTERA.

FAMILIES.	GENERA.	SPECIES.	FAMILIES.	GENERA.	SPECIES.
1 Cicindelidæ	1	6	19 Cleridæ	1	1
2 Carabidæ	24	39	20 Lucanidæ	6	9
3 Dytiscidæ	3	7	21 Scarabæidæ	21	44
4 Hydrophilidæ	4	4	22 Spondylidæ	1	1
5 Silphidæ	5	8	23 Cerambycidæ	21	25
6 Staphylinidæ	9	10	24 Chrysomelidæ	33	63
7 Coccinellidæ	11	17	25 Bruchidæ	1	5
8 Endomychidæ	3	4	26 Tenebrionidæ	8	12
9 Cucujidæ	1	2	27 Cistelidæ	1	1
10 Mycetophagidæ	1	1	28 Lagriidæ	1	1
11 Dermestidæ	1	1	29 Anthicidæ	3	4
12 Nitidulidæ	3	3	30 Meloidæ	2	3
13 Trogositidæ	2	2	31 Rhynchitidæ	4	11
14 Derodontidæ	1	1	32 Attelabidæ	2	5
15 Elateridæ	8	13	33 Otiorhynchidæ	10	13
16 Throscidæ	1	1	34 Curculionidæ	12	18
17 Buprestidæ	5	7	35 Calandridæ	2	2
18 Lampyridæ	3	3	Undetermined	7	7
			Total	222	354

About seventy-five per cent. of the genera occur in Canada, and while probably not more than half a dozen species are common to the two countries, there is on the whole a striking similarity of form and ornamentation, with a sprinkling of conspicuously exotic looking individuals. One such species is found in the Cicindelidæ (*C. chinensis* var?) which was abundant on the Usui Toge, about one hundred miles northward from Yokohama, and still more so at Chofu, near the straits of Shimenoseki, several hundred miles southward. This beetle is very gaily coloured and appears very brilliant when flying or running in the sunlight.

In Carabidæ the striking genus Damaster is represented by two species (probably *D. pandarus*, and *D. blaptoides*), from Chofu and Yokohama. There is a very fine Carabus, and among species closely resembling American forms may be mentioned two of Scarites, a Panageus, a Dromius, and four or five of Chlænius. Water beetles were not searched for, but among the few obtained are three fine species of Cybister and a Hydrophilus more robust in form than our *H. triangularis*. Staphylinidæ were not numerous, although the few species represented apparently furnish one which occurs in Canada, viz., *Oxyteles fuscipenne*, which flew into our chamber at Nikko one damp evening in great numbers, and a species more like *O. rugosus*, of which one specimen only was taken. Although the Histeridæ are not represented in my collection, I captured on Enoshima (island famous for glass sponges, shells and marine curiosities) a species much larger than any of the American forms known to me, but the specimen was afterwards lost.

One of the coasting steamers upon which we spent a day or two, swarmed with *Silvanus surinamensis*, and afforded also another cosmopolitan species, *Necrobia ruficollis*. A few specimens of Derodontus beaten from foliage at Yokohama, are perhaps identical with *D. trisignata*, which occurs in British Columbia. A curious Trogositid of a bronzy colour, with two yellow tubercles on each elytron, might from its size and sculpture be readily mistaken at first sight for a Buprestid near Chrysobothris. The splendid buprestid *Chrysochroa fulgidissima*, brilliant green with purple stripes on thorax and elytra, is not uncommon in the forest regions of Nikko and Hakone, and is said to infest several trees, including the Keaki (*Zelkowa Keaki*) which furnishes very valuable timber. There is also a smaller Chrysochroa, more subdued in colour, but still a very handsome insect, which appears to be less abundant. From the mountainous province of Shinshiu (famous for its silk-worms) I have two examples of a fine Chalcophora, much like *C. fortis* in sculpture, but larger .

The family Lucanidæ (Stag-beetles) affords several fine species, which quite overshadow the Canadian representatives of this family, while species of Scarabæidæ are both numerous and attractive, the most remarkable being the colossal *Xylotrupes dichomotomus*, of which the male has a long bifurcated horn on the head, and a shorter cleft one on the thorax. This fine species is apparently common in some districts, and good specimens can be obtained for three or four *sen*. At Hakone I obtained a living male, and at Yokohama picked up a dead female upon one of the Bluff streets. Several species of Anomala, Strigoderma, Euryomia, etc., were very abundant and did immense damage to various crops and to trees and shrubs. The most brilliant beetle of this family is a magnificent Geotrupes, of which I found several on the path from Hakone to Atami. Some of the Cetoninæ, however, vie with it in splendor and are perhaps more beautiful. I have not at hand *Spondylis upiformis* with which to compare the Japanese species, but it is very like the European *S. buprestoides*, with the costæ of elytra more elevated and the punctuation somewhat less dense.

The Cerambycidæ are very fine, and this family shows less resemblance to our fauna than perhaps any other, while still containing some familiar genera. A common species in the coniferous forests, and which I took upon pines on Fuji, is a glossy black beetle with white markings (*Melanauster Chinensis*, var, *macularia*), about the size and shape of our large pine-borer (*Monohammus confusor*). An allied species also from the forest at foot of Fuji, is *Apalimna liturata*, Bate, prettily marbled with grey and black, and with antennæ three inches long.

The profusion of vegetation naturally leads to a rapid increase of leaf-eating forms, and the Chrysomelidæ are correspondingly well represented in species and individuals, exceeding in these respects as well as in number of genera all the other families represented in my collection. While many of the species are pretty and of considerable interest, none are remarkably large or conspicuously colored. Other families are poorly represented until we come to the Rhyncophora, when numerous interesting forms are found. Rynchitidæ and Attelabidæ seem especially numerous in comparison with Canadian species, while Otiorhynchidæ and Curculionidæ have each some large and curious species, although the genera closely resemble our own. The pine woods yielded some fine species of Hylobius and closely allied genera.

Hymenoptera.

The members of this order have a more homelike look than the beetles, and very few genera occurred which are not represented with us, as will be seen by the following list of the genera and number of species in each family:

I. *Tenthredinidæ*,—Hylotoma 6, Cladius 1, Nematus 1, Harpiphorus 2, Aneugmenus 2, Athalia 3, Allantus 1, Macrophya 1, Tenthrede 1, Taxonus 2, Strongylogaster 1.

II. *Cynipidae*,—Aspicera 1.

III. *Ichneumonidæ*,—Ichneumon 8, Amblyteles 1, Trogus 2, Hemiteles 2, Ophion 1, Thyreodon 1, Anomalon 1, Campoplex 2, Paniscus 2, Limneria 1, Mesoleptus 1, Tryphon 1, Theronia 1, Pimpla 3, Glypta 1, Genus near Glypta 1, Lampronota 2, unplaced 2.

IV. *Braconidae*,—Bracon 1, Rhogas 1, Orgilus 1, Phylax 2, Apanteles 1, unplaced 1.

V. *Chalcididæ*,—Chalcis 2, Stomatocera 1, Lelaps 1, Eurytoma 3, Tetrastichus 2.

VI. *Proctotrypidæ*,—Proctotrypes 1, Goniozus 1, Sparasion 1, Macrotelia 1.

VII. *Chrysididæ*,—Chryis 1.

VIII. *Formicidæ*,—Camponotus 1, Formica 2.

IX. *Myrmicidæ*,—Myrmica 2.

X. *Mutillidæ*,—Sphærophthalmia 1, Chyphotes 1, Myrmosa 1.

XI. *Scoliidæ*,—Tiphia 3, Scolia 2, Dielis 4.

XII. *Pompilidæ*,—Pompilus 5, Priocnemis 1, Planiceps 1, Agenia 2.

XIII. *Sphecidæ*,—Ammophila 6, Spex 1.

XIV. *Larridæ*,—Lyroda 1, Larra 3.

XV. *Philanthidæ*,—Cerceris 3.

XVI. *Pemphredonidæ*,—Cemonus 1.

XVII. *Crabronidæ*,—Crabro 1.

XVIII. *Eumenidæ*,—Eumenis 4, Odynerus 4.

XIX. *Vespidæ*,—Vespa 3, Polistes 4.

XX. *Andrenidæ*,—Parasphecodes 1, Halictus 7, Andrena 5, Nomia 1.

XXI. *Apidæ*,—Cœlioxys 1, Megachile 3, Lithurgus 1, Ceratina 2, Synhalonia 1, Xylocopa 1, Bombus 5, Apis 1.

In all there are eighty-two genera represented by 162 species. The Saw-flies number twenty-one species, but are exceeded by the Ichneumons with thirty-three species, including several fine forms. The Ophion has chitinous spots in the sub-marginal cell as in *O. purgatum*, and the Thyreodon is identical in colour with *T. morio*, but is more coarsely sculptured. The two Chalcis are *C. minuta*, Linn, (a cosmopolitan insect), and *C. mikado* a handsomer species which was not rare on lawn shrubberies. Ants were seldom collected, so that the few specimens taken give no indication of the abundance in which these insects occurred at some places. The species of Tiphia and Dielis were very abundant, the former on umbelliferous plants at Hakone, the latter on lawns. One Pompilus seems identical with our *P. biguttatus* and the others much resemble American species. The species of Odynerus are larger than ours, and several individuals were found to be stylopized. Two of the wasps are very large and build immense nests, while Polistes were very abundant, building their nests in shrubberies. Among the bees is a very large Lithurgus, which apparently used the leaves of Wisteria for its nests, and a Bombus which seems identical with *B. lapidarius* of Europe.

NOTES AND QUERIES.

By Rev. W. J. Holland, Ph. D., Allegheny, Pa.

I have just received a specimen of a *Erebus odora*, which was captured last Wednesday evening in the lecture room of the First United Presbyterian Church in the City of Allegheny, where its appearance caused no little consternation among the devout "Mothers in Israel," who were at prayer meeting, and who thought it was a bat, of which evil things are said by the unsophisticated. It is a male in good case. This is the third specimen I have received this summer. The first was taken about four weeks ago in the cellar of my father's residence in Bartholomew County, Indiana The second was taken at Jeannette, Pa., near a spring house. All three specimens are fresh in appearance, as if not long from the chrysalis. Undoubtedly this great moth is more than an occasional visitor from the tropics, and should be reckoned as belonging to our fauna, though scarce. Its capture has been recorded north of the Ohio and Potomac many scores of times, and it has been taken repeatedly in Canada.

Papilio Cresphontes, Fig. 26, for the first time, has been taken this summer in the neighborhood of Pittsburg and in considerable numbers. One collector obtained four specimens in one locality. The food-plant is Zanthoxylum and Ptelea in these parts. In Florida its larva is abundant upon the orange and lemon trees.

One of the commonest of our Papilios is *Philenor*, Fig. 27. Here its larva is found upon Aristolochia. In southern Indiana, in Bartholomew County, I have observed it summer after summer, sometimes in immense numbers. It is one of the commonest butterflies there as here. But, with the exception of one or two specimens of Aristolochia growing about verandahs in the Village of Hope, I think I may safely say there is not a plant of Aristolochia within many miles of the fields in which I have counted the perfect insect by the score. What is the other plant upon which the larva feeds? It runs in my mind that I have read that the caterpillar has been found upon the smart-weed (*Polygonum hydropiper*) but I cannot recall where I have seen this statement made. I have never been able to verify it by observation. Perhaps some reader of the *Canadian Entomologist* may be able to throw light upon the subject.

The banana merchants in our town have proved themselves possessed of curious entomological stores. I have received from them a couple of living tarantulas, and not long ago a living specimen of *Caligo Teucer*, which had emerged from a Chrysalis, hidden

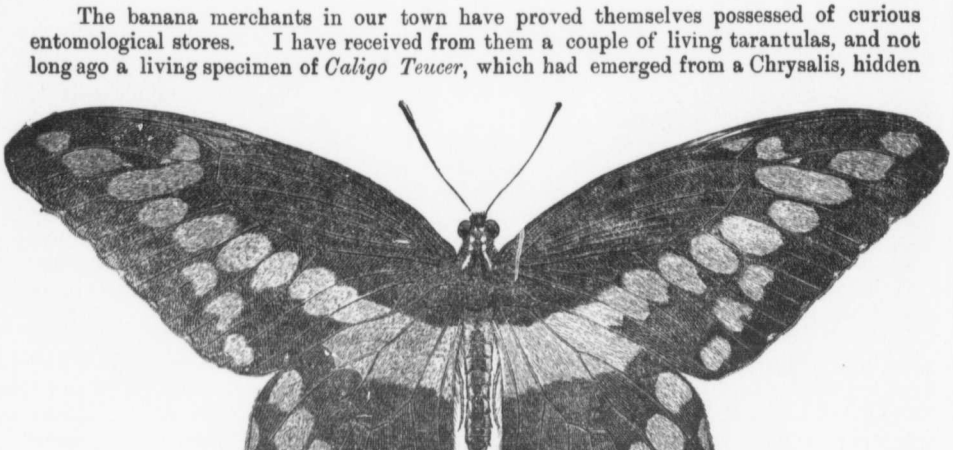

FIG. 26.

in a bunch of bananas. The insect had been transported by sea and land from either Honduras or some port in the northern portion of South America, a journey of several thousand miles. This reminds me that in several consignments of eastern lepidoptera I

FIG. 27.

have found one Danais plexippus, Linn. One of the sendings was from Borneo, the other from Java. We shall soon hear of its domestication on the mainland of Asia, and it will probably spread all over China and Japan. The insects taken by the U. S. Eclipse

Expedition of 1889, at the Azores, numbered among them two specimens of the butterfly. There were only about a dozen specimens of insects taken at the Azores by the industrious (?) naturalists of the party, and I judge that it must be common there. Why we have not yet heard of its domiciliation on the African continent is a mystery to me. It will, no doubt, get there before long.

I have a specimen of Limenitis taken in Warren County, Pa., this summer, which is most remarkable. It has all the markings of L.ursula, but both the primaries and secondaries are crossed by very broad white bands as in L. Arthemis. It is, however, larger than any specimen of Arthemis I have ever seen, and exceeds the majority of L. Ursula in size. It has the white spots in the cell of the primaries, which appear in some female specimens of L. Weidemeyeri. It is altogether a queer beast combining the characteristics of three of our species. No doubt they all sprang from a common ancestry, and this specimen reveals the force of atavism.

THE DRAGON-FLY.

By T. J. MacLaughlin, Ottawa.

As Economic Entomology has become so important a subject to the farmer, fruit-grower, gardener, and others, and as all insects are now regarded as either noxious or beneficial, a few words in reference to the Dragon-fly might not, perhaps, be without interest, and might assist those who may not be conversant with its habits in assigning it a proper place in the field of economy.

The dragon-fly family—*Odonata*—belongs to the order *Pseudo* (or false) *Neuroptera*. That is to say, to that order of mandibulate insects having four membranaceous reticulate wings, and which undergo an incomplete *metamorphosis* or transformation.

The family is divided into three tribes: *Agrionina*, *Aeschnina*, and *Libellulina* and these again into sub-divisions.

The first tribe, *Agrionina*, embraces all the smaller forms—commonly called hammer-heads—and some of the most beautiful of the whole family, such as the different species of Calopteryx, as the name implies. *C. maculata*, *C. virginica*, *C. æquabilis*, etc.

The wings of all the species of this genus are densely reticulate, broad at, or near, the apex, or tip, and very narrow at the base, with many anticubital veins, and the pterostigma wanting in the males; the color of the wings varies according to the species—jet black, brown, hyaline, semi-transparent and clouded; and the head, thorax and abdomen are of a light green or blue. From their erratic course, the color and comparatively slow motions of their wings, and habit of alighting so frequently, they are readily mistaken for butterflies. They proceed from and spend their life along swift running waters, especially such streams as flow through woods or shaded places; while the other insects of the same tribe—the Agrions, etc., proceed from and frequent only stagnant pools, or the borders of very sluggish streams. This tribe is composed of two sub-families and two legions, with many genera, sub-genera and species, all presenting the same peculiarities—slow, graceful flight and delicate constitutions. The noiseless, gentle movements of these pretty little objects (and they are sometimes found together in vast numbers) dressed in many colors, is truly a picture of combined beauty, ease and contentment, rarely seen. Thousands of the small creatures might float through the air about the ears of the beholder and not a sound could be heard to indicate their presence. They show their affection for each other in the most impassionate and gentle manner; the male, with the little forceps at the extremity of his abdomen, clasps the female gently about the neck, and in this way they fly away on their hymeneal wanderings in the same slow and careless manner which characterizes their movements when flying alone.

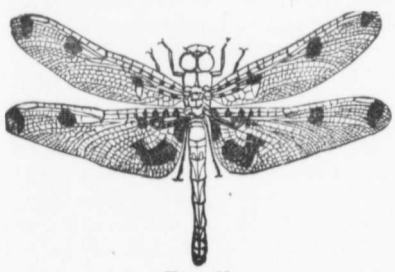

Fig. 28.

Tribe II., *Aeschnina*. This tribe is sub-divided into two families: *Gomphina* and *Aeschnina*. The latter contains the largest and most repulsive of the dragon-flies. The head is large; the eyes are connected from near the labrum, or upper lip, to the upper part of the head and cover both sides down to the jaws, or mandibles. The mandibles are large and powerful and the thorax is of immense proportions. The abdomen is long and slender, and upon capture the insect will coil and slash it about, which always gives the capturer the impression that it is feeling for a place to sting. The wings are broad and strong, and have little of the colors which beautify those of the other tribes. *Aeschna heros* is the largest of the species; it measures about 3½ inches in length, including the appendages, and the expansion of the wings is about 4 inches. The insects of the first tribe—Agrionina—fly low and are seldom seen far away from their natural haunts, but nearly all the species of Aeschnina are high fliers and are met with everywhere, in the woods, fields, on the tops of mountains and in the valleys, continually searching for food; devouring every soft-bodied insect which crosses their path, and looking for more.

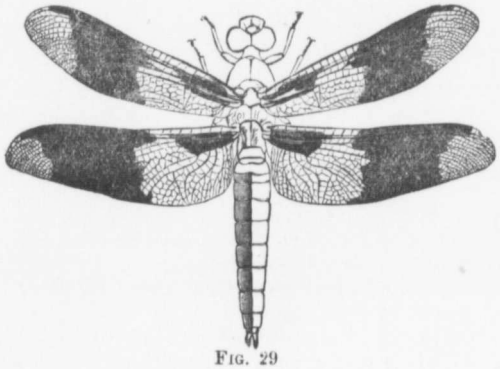

FIG. 29

FIG. 30.

Tribe III., *Libellulina*. This tribe is divided, like the preceding, into two subfamilies, Cordulina and Libellulina. The Canadian genera are Macromia, Epitheca, Cordulia, Plathemis, Libellula, (Fig. 29, *L. trimaculata*), Diplax (Fig. 28, *D. Elisa*: Fig. 30, *D. Berenice* male; Fig. 31, *D. Berenice*, female), and Nannophya (Fig. 32, *N. Bella*). The prettiest of all our large dragon-flies belong to this division. They are less repulsive and voracious than those of Aeschna, and the wings of most of the species are beauti-

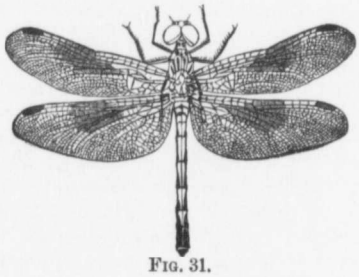

FIG. 31.

FIG. 32.

fully marked with clouds of various hues. They are readily distinguished from those of the second tribe—although nearly equal in size—by the abdomen alone; this member is not capable of being coiled up; it is comparatively short, stout at the base, and gradually tapers off to the end. The segments are joined closely together and the whole moves, to a very limited extent, up and down on the first segment, after the fashion of the moth and butterfly.

With this short and very imperfect description of the three tribes in the perfect, or winged state, something may now be said with regard to the earlier stages of their existence. Dragon-flies are then wholly aquatic animals and are carnivorous in all their stages. The parent fly lays her eggs in the water; some drop the eggs in while flying over the water; others submerge the abdomen and glue the eggs to reeds or sticks, while certain species go below the surface several inches for the same purpose. It is not definitely known how long the eggs are in hatching, nor the length of time the young remain in their larval and pupal states, but the water period of existence is variously stated to be from one to three years, the time varying according to the species. It is known, however, that they all feed upon other aquatic forms of animal life, to a large extent upon the larvæ of the mosquito, etc. The larva (Fig. 33, left hand), can only be distinguished from the pupa (Fig. 33, right hand), by the latter having wing pads, the insect being equally active in both stages. When the pupæ are ready for transformation they crawl out of the water upon the stems and branches of plants, secure a firm hold and remain until the skin is dried, which then

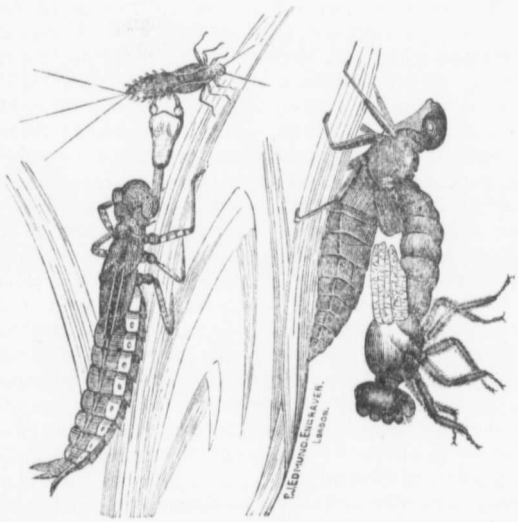

FIG. 33.

splits on the back and the perfect insect comes slowly forth, leaving the hull or pupa case clinging to the plant. Many of these may be seen long afterwards in the same position on reeds and grasses, along the borders of streams, ponds, etc. After coming from these a short time is required to dry and expand the wings; then away flies this beautiful creature, with gauzy wings of many colors, which, but a few moments before, was a horrible, repulsive, voracious object, crawling over the slimy bottom of a filthy pool of stagnant water. Some of the larger species of these insects are very sluggish in their larval state, and on this account nature has endowed them with a very remarkable weapon (Fig. 33 left), which enables them to capture their prey in this and their pupal state, as readily as they can afterwards do upon the wing; it consists in a prolongation of the under lip, which is very long and shaped like a ladle, the end terminating with two in curved hooks or mandibles. When the insect is at rest this elongated lip is folded and concealed beneath the under jaw until some luckless creature comes within striking distance, when out slips this trap-like apparatus (against which its victim has made no provision) and secures the booty.

With regard to their manner of breathing, Duncan, in his work on the transformation of insects, says: "The larvæ and nymphs, although living under water and must respire, have no external organs by which they can breathe. Their method of respiration

is unique; they breathe with their intestines. The large intestine is covered with numerous tracheæ, and when the animal wishes to breathe it opens the orifice of the intestine and admits a quantity of water. This, of course, contains air mechanically suspended which is taken up by the tracheæ just mentioned." In expelling the water just taken into the intestine, it is sent out with considerable force, which propels the animal forward with a jerk, several times the length of its own body; by this means it keeps out of the way of its enemies.

Dragon-flies are the most harmless creatures in existence, utterly incapable of injuring man or beast, but, on the contrary, highly beneficial in all stages, inasmuch as they are the natural enemies of the mosquitoes, house-flies, moths, and other noxious insects, which would abound in greater numbers and interfere much more seriously with our comfort and our products than they do under the continuous and effective check of the dragon-fly. Yet, strange to say, these insects are not known by five-tenths of the people of Canada, and most of those who know them by name are not acquainted with their habits, but—to quote from a previous article on the subject—"Avoid or destroy them on account of the mistaken impression which some people have as to the poisonous effect of their sting, or the childish tradition as to their habit of sewing up the eyes and then stinging their victim to death." Others admire them for their beautiful colour, slender forms and graceful motions.

They are known by various names and epithets, such as: Devil's darning-needles, mosquito-hawks, horse-stingers and some others in English. The Germans call them Wasser-jung-fern, or virgins of the water. The Indian knows them by the name of Kow-ne-she, or Duch-kow-ne-she, and the French are pleased to style them Demoiselles. The last does not seem so appropriate as some of the other appellations, as the points in which any of these creatures resembles a lady, are not clearly defined, unless it be in their slender waists. I know that some of the large ants are called Demoiselles by the French, and their delicate forms rather suggest the name, but with all their admiration for the beauty and modesty of women, I agree with Duncan when he says: "No Frenchman would think of comparing a dragon-fly with a lady, if the nature of this animal was known" In this part of Canada dragon-flies begin to issue from their pupa cases about the midlle of May, the first appearing are those of the genus *Libellula*, and by the 10th of June all the different species may be found on the wing. After the middle of September they gradually disappear, but some of the hardy species, such as *Diplax hudsonica* and *Aeschna verticalis* and *venosa*, may be seen well on in November, apparently as vigorous as they were on starting out, and hungry enough to devour the elements.

It is interesting to know that even at this late date the Odonata is beginning to assert its personality, and the services so long rendered by this family of insects are now being observed, acknowledged and appreciated, not only by naturalists, but by many who do not pretend to make a study of the subject, as the following will show: A few years ago, while engaged in building the Lake Superior and Mississippi Railway, Dr. R. H. Lamborn, of New York City, had occasion to make frequent excursions, in the capacity of director and treasurer of the company, through the swampy forests around the head of the great lake, and his experience with the mosquito and other troublesome flies of that region was so impressive that he determined to array his own with all other natural forces against them. Having observed the activity of the dragon fly in the destruction of the mosquito, and also having witnessed an entomologist feeding a dragon fly that had eaten thirty house-flies in rapid succession, without lessening its voracity, the thought came to him that the artifical multiplication of the dragon fiy might accomplish a mitigation of the mosquito and house-fly pests. He accordingly sought among entomological works for some account of experiments tending to throw some light upon the subject, but without the desired result. Finding that science had left those investigations almost untouched, and that there was nothing in the known life history of the dragon-fly that would enable him to form an opinion as to the possible success of such an undertaking, he addressed letters to Dr. Uhler, of Baltimore, the highest American authority in the great class of insects to which the dragon-fly belongs, and Rev. Dr. McCook, another naturalist of high standing, and having received the greatest encouragement from both of those gentlemen,

as to the importance and possible practicability of his scheme, Dr. Lamborn at once placed $200 in the hands of M. K. Jesup, president of the American Museum of Natural History, New York, to be paid by him in three prizes of $150, $30 and $20 for the three best essays based on original observations and experiments on the destruction of mosquitoes and flies *by other insects*; the prizes to be awarded by Dr. H. C. McCook, Vice-President of the Academy of Natural Science, Philadelphia, and Dr. J. S. Newberry, President of the New York Academy of Science. A circular was accordingly prepared in July, 1889, and sent to the working entomologists of the country, embodying the conditions and the object of the contest. The time given to respond was five months. It is not stated how many took part in the contest, but at the end of the time given, awards were made as follows: first prize to a lady, Mrs. C. B. Aaron, of Philadelphia, and the second and third equally divided between Mr. A. C. Weeks and Mr. Wm. Beutenmüller, both of New York City.

These three essays, with nine plates showing several species of dragon-flies, house-flies and mosquitoes in the various stages of development and the different devices suggested for the extermination of the mosquito, along with bibliographical lists of the authors quoted and literature on the subject, an article by Dr. H. C. McCook, and a letter from Capt. Macaulay, were published by D. Appleton & Company, New York, under the title of "Dragon-flies *vs.* Mosquitoes," in a handsomely bound octavo vol. of 200 pages.

Mrs. Aaron's experiment with petroleum is so interesting and valuable that we feel constrained to make the following quotation. On page 63 she says: "The United States Department of Entomology and the various State reports, as well as numerous entomologists abroad have long recommended the use of petroleum in some form for the extermination of plant lice and many other noxious insects. Petroleum emulsion, sprayed petroleum, the naphtha compounds and others from the same source, are prompt and deadly insecticides. With this in mind, we early began a series of tests with common illuminating oil on culicid *larvæ* under all circumstances. The narration of one series of experiments, typical of all, will illustrate the efficacy of this treatment. In a shallow pool of water with an area of ten square inches, five pupæ, two grown larvæ and about six others in various stages of development, were put, with them, also two immature Odonata, and a number of Cyclops and Cypris. On the surface ten drops of oil were placed and were observed to cover the whole area in ten minutes. At once great uneasiness was manifested by the larger larvæ. Then they all began cleaning off the breathing tube with their jaws, with apparent discomfort. The evident effect of the oil was to coalesce the cilia at the tip of the tube, thus making respiration difficult or impossible. The annoyance, fear, agony and finally desperate frenzy, were clearly depicted by their actions. The two grown larvæ were dead in eight minutes; several of the half-grown died in ten minutes; at the end of twelve minutes most of the remainder, save the very smallest had succumbed. The pupæ had both expired in fifteen minutes. In an hour and a half everything was dead except the Odonata and minute crustaceans; the former seemed to be in in perfect condition owing to their multitudinous breathing appliances. After the oil had been put on the above area, it was at once seen that the proportion was too great. A second pool of the same dimensions was tried with one drop of oil which was quite enough to have the same deadly effect, though the results were not so rapidly attained. The all-pervading nature of the oil was shown by the fact that one of the larvæ removed to a pool of eight square inches of surface took enough oil with it to cause almost intense uneasiness to the inhabitants of the otherwise fresh water.

These experiments were tried time after time, always with the same result, and show conclusively to us that oil is the great hope of nearly every mosquito infested district, for the following reasons: (1) Its cheapness; (2) its deadly nature when applied to the culicidæ; (3) its comparatively harmless nature as applied to other forms of aquatic life; and (4) the ease with which it can be applied.

It is obvious that the time allotted was far too short to admit of much original observation or experiments along the lines of the scheme which brought forth the call for the contest. Had the time been two years instead of five months and the prize correspondingly great, the results would have been much more important and the conclusions

perhaps very different. As it was the essayists—not having had time to prosecute experiments in the artificial culture of the Odonata, were obliged to draw conclusions from what had been done by others in that way (which was almost nothing) or from their own imagination—without data, both as to the possibilities of artificial multiplication of the dragon-fly and the effect that such would have on the mosquito and house-fly.

Time will not permit giving even a short account of the other essays; suffice it to say, all the important scientific knowledge on the subject up to the year 1890 has been reproduced in concise and accurate form, and it must be admitted—even if nothing more is done as a result of this initial step—that the collection of all the scientific knowledge on the subject in an easily accessible form is well worth the time and outlay; and it is not too much to say that Dr. Lamborn has not only assumed a neglected function of the state and thus shown the Government an example in this philanthropic movement, but he has placed science and humanity under an obligation.

Sufficient has been produced to show that the dragon-fly is the most beneficial insect at least in the order to which it belongs, and deserving of a foremost rank among the insect friends of man.

THE SONG OF THYREONOTUS.

By William T. Davis, Staten Island, N. Y.

Mr. Samuel H. Scudder, in the Report of the Ontario Entomological Society for 1892, gives an interesting account of the "Songs of Our Grasshoppers and Crickets," and kindly permits the stridulations of a number of Staten Island insects to be heard mid the general medley. There is, however, an addition songster to be added to this list, as appears from the following.

On the 26th of last June I heard in a moist pasture, on the north shore of the Island, a stridulation that was unknown to me. It much resembled that produced by *Orchelimum vulgare*, with the preliminary zip, zip, omitted. It was a continuous *z e e e*, with an occasional short *ik*, caused by the insect getting its wing-covers ready for action after a period of silence. It was too early for *Orchelimum vulgare* by about a week; at least I have never heard one on the Island before the fourth of July; so in the present instance I made careful search for the musician. In due time I discovered, in a tussock of rank swamp grass, the brown songster perched on a dead leaf, and receiving the evidently welcome rays from the afternoon sun. It was *Thyreonotus pachymerus*, and in the swampy field about me I heard others of its kind, so that this individual was only one of a considerable colony.

A failure to make proper use of his legs (the wings are abortive) resulted in the transfer of Thyreonotus from the tussock to a tin can. At home I made a bowery for him in a larger tin can covered with netting, into which was introduced a branch of the coriaceous leaved post oak, and when the leaves dried, there were innumerable nooks and crannies wherein to hide. Usually, however, the insect did not hide at all, but perched himself on one of the topmost leaves and there waved his antennæ after the manner of all long-horned Orthoptera. Starting with raspberries, he had the rest of the fruits in their season, including watermelon, of which he showed marked appreciation. If I offered him a raspberry, and then gradually drew it away, he would follow in the direction of the departing fruit and would finally eat it from my hand.

As the bowery was kept in my bed room, I had the full benefit of the songs of its occupant, and was often awakened in the night by his sudden, alarm-like outburst of melody. He stridulated with unabated zeal to the first of August, when I noticed that his energies were lagging—he seemed to be much less sprightly. Finally his song, instead of filling the room, was but a faint sound, and I was obliged to place my ear close to the tin can. This was nearing the end, which came either on the tenth or eleventh of September, I cannot say which, for the bowery was not disturbed until its occupant had been missing from the upper leaves for several days.

Once or twice during his captivity he took unnecessary alarm at my well-meant efforts to "fix" the bowery, and whacked his head most insanely against the tin can, being propelled thereto by his muscular hind legs. However, no harm seemed to result from these little fits of nervousness, and he evidently died quietly enough in the end.

I have observed in other kinds of grasshoppers the subsidence in the volume of song as they grew older, which evidently makes it unsafe to take the efforts of a single individual as the standard of the species, especially if the time is late in the fall.

NOTES ON SOME OF THE MORE IMPORTANT ENTOMOLOGICAL EXHIBITS AT THE CHICAGO EXHIBITION.

By James Fletcher, Ottawa.

There was much for the economic entomologist to see and learn at the wonderful exhibition, which has recently closed at Chicago. The beautifully arranged and comprehensive exhibit made by the Division of Entomology of the United States Department of Agriculture was alone worth a visit to Chicago to see. A full catalogue of this collection has been published by Prof. Riley, and every economic entomologist should endeavor to obtain a copy of this instructive work while it is available. As it has been distributed in large numbers to the many interested visitors it is not expedient to more than draw attention here to some of the most striking features. The interest manifested in the exhibit by the constant crowds around the cases must have been very gratifying to those who conceived and carried out so excellently this invaluable object lesson of the utility of applied entomology.

Conspicuous objects on entering the court were wax models of a full-sized cotton plant, a plant of Indian corn and a species of Golden rod. These models were most accurate and realistic, and were shown as representatives of a new line of entomological illustration. The first two were chosen as being important and characteristic economic plants of North America, the Golden Rod as being one of the conspicuous and widespread floral forms which add beauty to our autumn scenery and which is very attractive to insects. Beneath these models were systematically arranged all the insects known to injure or frequent the plants.

There were 129 distinct enemies of the corn plant represented; these were arranged according to the nature of their injuries, i. e., as affecting the root, stalk, leaves or ears. The different stages were shown, and references to the literature were given as well as the best remedy. Around the hill of ripening cotton were arranged 37 species of insects. The model of the Golden rod showed the large number of insects which visit the plants of this genus either to feed on the different parts or attracted by the nectar of the flowers. Near these exhibits were enormous models of some of the best known crop pests, such as the Hop-plant Louse, the Chinch bug, the Australian Fluted Scale and its chief enemy, the Lady-bird, *Vedalia cardinalis*, which has done such good work of late years in controlling this pest not only in Australia, but in California where it has been introduced by Prof. Riley. Some anatomical models representing the Silkworm, Honey bee and Cockchafer were also exhibited. An interesting collection of silk insects showed the more important native and foreign Lepidoptera pro luing cocoons of commercial value. What was styled a "professional exhibit" displayed the apparatus used in collecting, rearing, mounting and preserving insects.

Of special interest to the economic entomologist and farmer were the insecticides, and the spraying and other implements for their application. There were about eighty samples of insecticides, and among other things a full collection of the various kinds of spraying nozzles, the working of which was shown and explained by an assistant in charge. Around the walls was arranged a collection of illustrations of insects and other objects which have from time to time appeared under the entomologist's direction.

The section of systematic and biologic entomology consisted of a great number of cases showing different orders of insects which were not exhibited as a "complete series, but as samples taken from the actual collection to illustrate the methods employed in the arrangement of the regular systematic and biologic series, and also to give the visiting entomologist an insight into the present state of the national collection."

A collection of great interest was one prepared under Prof. Riley's direction by Prof. J. B. Smith, and was intended to illustrate all the families of insects found in North and South America. Every known family of insects on this side of the world is indicated in it. This collection is unique. It was intended as a synopsis of the families of American insects illustrated by the specimens themselves or drawings—in almost all cases the families are represented by specimens. The labels are all in Prof. Smith's handwriting, and together with the arrangement bear witness to the labour and care expended on them.

The next collection calling for mention was the collective exhibit of the agricultural colleges and experiment stations. This was made up of contributions from the entomologists of some of the State experiment stations, and showed great variety in the methods adopted and the excellence of the work. There were, of course, features of interest in all, but some were so far superior to others that they at once drew the attention of the visitor. Prof. Harvey, of Maine, sent five beautifully neat cases, illustrating by means of specimens and coloured drawings the work of the Apple Maggot. Prof. Hopkins, of West Virginia, provided fifteen cases of forest insects, which were put up very neatly with printed labels and good specimens of insects and their work. One case was devoted to parasites. Prof. J. B. Smith contributed an extensive collection, showing in ten cases the insects of the cranberry, grape, blackberry, sweet potato and squash. These were put up with Prof. Smith's usual care and labelled in a legible manner, which unfortunately could not be said for all the collections. One collection particularly, of eight cases of neatly arranged biological material, lost much in appearance from bearing large labels in ugly back-hand writing.

At first sight Prof. Smith's cases seemed too much crowded with specimens, but this was done intentionally to draw more attention, as he maintains that farmers for whom, after all, this sort of collection is prepared, will frequently fail to recognize a species if only one or two specimens are shown him ; but, where, as for instance in the cranberry *Teras*, he is used to seeing swarms of them flying on the bog, a series of from twenty to thirty appeals to him at once, and he recognizes the insect. For the same reason large specimens of insect injury were introduced. A farmer is involuntarily attracted to a large specimen and to a striking injury. His eye is caught by seeing what was apparently a large vigorous plant badly damaged. The object is to give one seeking for information plenty to look at and abundant opportunity to examine the specimens. There is also another feature. If an insect is represented by only two or three specimens and perhaps one or two larvæ, it conveys the impression that these insects are rather rare, that it is difficult to get specimens. The object is to convey the idea that the insects shown are abundant and that they are to be respected from the point of the numbers in which they occur, if not on account of the size of the individuals.

In the exhibit of apparatus for entomology there are three more cases from the same station, showing insects injurious to Indian corn ; the apple, pear and quince ; and one of the Wheat louse and its enemies. These were meant to illustrate the manner of preserving all kinds of specimens and as a sample of the collection of an experiment station. No effort was made to have these complete—that would be impossible in the space—they were rather as a suggestion how a thing should be done than as an exposition of the subjects themselves.

Near the above mentioned cases was a sample of the Cornell case, in which everything is arranged on a separate block so as to facilitate removal if necessary. Without knowing the advantages claimed for this arrangement, I must be acknowledged, I think, that the general effect is less tidy than the ordinary method. There were collections from Prof. Bruner, of Nebraska, showing enemies of the sugar beet, several cases from Prof. Osborn, of Iowa, and six very neatly arranged cases of apple insects, together with coloured drawings of their work, prepared by Prof. Popenoe, of Kansas.

In connection with the agricultural exhibits of some of the States were several collections of insects. Minnesota showed specimens of Coleoptera, Lepidoptera, the bee moth, and injurious locusts, all well mounted and arranged. Several colleges and schools also made exhibits. The most important of these was that made by the Illinois State Laboratory of Natural History, under the direction of Prof. S. A. Forbes. This was a most instructive, well arranged and well prepared display. It illustrated the methods of work and lines of study pursued. Fronting on the main aisle was an office fitted for entomological work, such as might be occupied by an entomologist and two assistants, one for office and one for field work, and an amanuensis, showing arrangement of tables and cases, all supplied with the necessary apparatus and reagents. Examples of the library, library catalogue, collections of all classes of material, records with their indexes and methods of keeping notes, also appeared here. A full set of the publications of the State laboratory and State entomologist's office were here displayed. The size of this room was twenty by twenty-seven feet. At the back of this office was a small section of an insectary, fitted with breeding cages for all kinds of insect life, sand tables, various insectary supplies and apparatus for experimentation and study in the contagious diseases of insects. This measured eleven by twenty feet. On the outside of the enclosure just described, and in adjoining cases are ranged the collections illustrating the various lines of work pursued at the State laboratory. The economic work is represented by four collections, one shows the insects injurious to the apple in all stages as far as obtainable, to the number of 176 species. It may be mentioned *en passant* that Dr. Lintner has now on record the names of 282 species of insects injurious to the apple. The second collection showed the injurious insects of corn in the same way, numbering 149 species; the third, those of wheat, fifty-seven in number, and the fourth, those of the strawberry plant, fifty species. The more minute forms are accompanied by exquisite water colour sketches, the work of the laboratory artist, Miss Lydia M. Hart, showing their appearance when magnified. The boxes are fifteen and a quarter by eighteen inches, and two and a half deep within. The front and back of glass, the sides of wood separable into two halves along the middle of the sides. The back is lined with sheet cork attached to the glass by a wax mixture, the cork covered with paper of neutral olive tint, which greatly enhances the appearance of the specimens. Half-sized boxes are used where the space requires it. Studies on the foods of animals were represented by three collections A most remarkable exhibit which drew much attention was that of the average food of a robin during the part of the year that that bird is in Illinois, as determined by percentages obtained from the study of 114 stomachs of these birds taken at all times and seasons The quantity as well as the kind of each element is shown, and illustrates well the difficulty which sometimes meets one in determining whether a certain bird or animal should be considered beneficial or injurious. Eleven full-sized boxes are used; they contain 5,481 pinned specimens and 111 tubes of alcoholic material, mostly eighteen inches long, which is the full length of the box. Eleven of these tubes exhibit the vegetable elements of the food. A collection of insects found in the food of birds contains 195 species, and one of those found in the food of fishes includes ninety-one species The insect fauna of the State is illustrated in two collections, the common insects of the State numbering 1,578 species, occupying sixty-nine cases. In nine boxes is shown the geographical distribution of the commoner Illinois butterflies, those occurring throughout the State, those peculiar to Southern, Central and Northern Illinois; those found also in Europe, in the Atlantic States, and in the Pacific States are separately grouped. A collection of 459 species of pinned insects is exhibited, which is one of forty collections lately made and distributed to high schools of Illinois which were in need of them.

Several collections of more or less interest were exhibited from foreign countries. Most of these were unnamed, consequently of no value for reference. Russia and Germany showed grand collections of forest insects. Canada was represented by a collection of about twenty cases prepared by myself, with the assistance of several members of the Entomological Society of Ontario, who kindly contributed specimens. The moths, filling eight cases, were arranged by Mr. J. Alston Moffat, and two cases of Hymenoptera by Mr. W. Hague Harrington. The collection of Diurnal Lepidoptera was probably one of

the most complete in Canadian species which has ever been brought together. When this collection is returned, it will become the nucleus of a collection at the Central Experimental Farm at Ottawa.

THE FIFTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The fifth annual meeting of the Association of Economic Entomologists was held at Madison, Wisconsin, in the Science Hall of the University of Wisconsin, on August 14, 15 and 16, 1893.

Sixteen members were present, as follows: President, S. A. Forbes; Second Vice-President, J. B. Smith; Secretary, H. Garman; J. M. Aldrich, G. F. Atkinson, G. C. Davis, C. P. Gillette, A. D. Hopkins, L. O. Howard, M. E. Murtfeldt, H. Osborn, C. V. Riley, P. H. Rolfs, H. E. Summers, F. M. Webster and H. E. Weed A number of visitors and members of other scientific associations were present during the sessions, making rather a large attendance.

The following papers were presented, among them several from foreign entomologists, and the discussions were of the greatest interest.

The annual address of President S. A. Forbes reviewed the 115 economic articles containing new matter published by members of the association since the last meeting. These articles he grouped by subjects and by nature of outcome, thus giving an admirable idea of the work of the year in shape for the drawing of conclusions. He called attention to a narrowness of view and consequent inadequacy in the treatment of general questions, due to the want of comprehensive organization and systematic co operation. In his opinion the methods of publication and enforcement of results now in general use, fall far short of their final end. As a result the farmer has not responded to the suggestions of the investigating entomologist as might be anticipated. He suggested that more attention might be paid to describing the effects of insect work than to the insects themselves, subordinating the account of the insects. He insisted that instead of making an entomologist of the farmer we should make a farmer of the entomologist. He suggested, distinguishing between the temporary and permanent presentation of facts in economic publications, advising the preparation of special economic summaries or monographs of all insects injuries to each of the various crops, and printing and distributing these summaries in great numbers. Co-operation in this particular line was urged. Addresses to Farmers' Institutes should be accompanied by a printed résumé to be distributed among those present.

"But now," to quote the language of the address, "supposing full and accurate information widely disseminated and in the actual possession of those for whom it is especially designed, we have next the most difficult task of all; to make sure that it will be practically applied. What shall we do and what advise to secure a common action in accordance with known and admitted facts? Shall we leave this to the individual and to the coercion of neighborhood opinion, or, these failing, shall we look to the law and to agencies established under the law? In short, are we practically individualists or socialists in our leanings? The official entomologist, I need hardly say, need not shrink from the word socialism, for as a Government official he is himself a socialistic product; as much so as the experiment station or the public school. Without attempting here to debate so large a question, I venture to express my own opinion that we should look to the law and to some regularly established system of inspection and penalty enforced by law to supplement the spontaneous agencies of society where these fail to protect the industrious and intelligent against the destructive consequences of neglect on the part of the idle and the

*Through the kindness of Mr. L. O. Howard, of the Division of Entomology, Department of Agriculture, Washington, D.C., who has furnished us with an abstract of the official minutes and also proofs of the full report, prepared for *Insect Life*, we are enabled to give this account of the meeting, together with some of the most generally interesting papers.—ED.

ignorant. There are regions—those parts of my own State worst infested by the Chinch Bug, for example—where there seems really to be no choice between legal compulsion on the one hand and the slow and enormously expensive operation of the law of natural selection on the the other. Either the slow processes of social and economic revolution must be allowed to take their destructive course, carrying down too often the bright and willing farmer with the hopelessly sluggish mossbacks all around him, who breed insects by the bushel to devour his crops with their own, or we must have a State or county board, acting in conference with the official entomologist, empowered to recommend a protective proceedure in cases which are clear beyond all reasonable controversy and to assign penalties for a failure to conform. I would, myself, advise both State and county boards—perhaps those agricultural boards already existing—on the ground that it is useless to attempt to enforce measures, however plainly necessary, against the common sentiment of the locality."

He then spoke of the fact that the boundaries of the State represented by official entomologists are artificial, and that in consequence matters of distribution and other broad questions are seldom touched. This fact and the danger of unnecessary duplication of work, and other reasons, called for organization, and this organization should be of flexible form, leaving each individual free to meet the special requirements of his individual work, and at the same time helping to concentrate the surplus effort which should be contributed to the accomplishment of common ends. He suggested that a committee on co-operation propose a list of subjects in which co-operative effort is desirable. These subjects should then be attacked by volunteers, who should report to the committe. In this way, he thought, that the benefits of organization might be obtained without the surrender of individual initiative.

The address was discussed by Messrs. Osborn, Smith and Webster. Mr. Osborn thought that laws requiring farmers to destroy insect pests appearing on their farms could be made effective, and gave the operation of the Canada thistle law in Iowa as an example. He thought that such laws should apply in all cases only to such pests for which good remedies could be recommended. The Fall Web-worm could, he thought, be easily controlled in his State if everyone was required to destroy it whenever it appeared on his place.

Mr. Smith spoke of the difficulty of inducing many farmers to take any precautions in checking the injuries of insects, and thought that laws requiring them to give attention to such matters could not be enforced. The weed law of New Jersey was mentioned as an example of the ineffective working of such laws. He was of the opinion also that the number of laws required, if one were made for each pest, would be a difficulty not easily surmounted, since it was not easy to get legislators to pass such laws.

Mr. Forbes thought a community which would not enforçe laws relating to farm pests must be left to suffer, but he had known instances where public opinion on these matters was such as to compel farmers to give them attention.

Messrs. Osborn, Smith and Garman were appointed a committee of three to consider the recommendations contained in the address.

Messrs. Edward H. Thompson, of Tasmania, R. Allan Wight, of New Zealand, and G. C. Davis, of Agricultural College, Michigan, were elected to membership.

Mr. Osborn presented a paper entitled "Methods of Treating Insects Affecting Grasses and Forage plants." In this paper he considered the insects affecting these crops by groups arranged according to the method of treatment, discussing particularly climatic conditions, natural enemies, agricultural methods, and the direct method. He presented a most interesting table of insects, showing in horizontal columns the food plants, number of annual broods and the condition in which the species is to be found during any month in the year, and closed with the following practical recommendations:

"(1) A general rotation of crops, especially for clover and for meadows generally, and change at the end of four or five years at the most.

"(2) Where it is desirable to keep the same field continually in grass or for a long series of years, as in rough land or woodland pastures, attention to the maintenance of trap lights, the use of arsenical baits or applications, burning, and the tar pan should be practiced, especially after the second year.

"(3) To allow ground squirrels, moles, and other natural enemies to carry on their work unmolested, and in case their multiplication affects surrounding crops to adopt means of protecting such crops without destroying these animals. If in localities where fertilizers may be used with profit, to adopt the use of such kinds as nay have insecticidal properties."

The paper was discussed by Mr. Hopkins.

The next paper, by Mr. Howard, was entitled "Notes on Methods of Studying the Life-histories of Injurious Insects," in which he described the vivarium methods in use in the Division of Entomology of the U. S. Department of Agriculture, but insisted that out-door work is preferable where feasible. The question of methods of ventilation of the insectary and kindred topics were discussed by Messrs. Forbes, Garman and Howard. Mr. Forbes thought that in-door work on life-histories should always be verified by out-door observation.

Under the caption, "Another Mosquito Experiment," Mr. Howard detailed as follows his experience, with the use of kerosene on the surface of mosquito-breeding pools, since his announcement of his first experiment a year ago.

ANOTHER MOSQUITO EXPERIMENT.

By L. O. Howard, Washington, D.C.

Just as "one swallow does not make a summer," one experiment does not fully satisfy the economic entomologist of the value of a remedy. At the last meeting of this association I laid before you the facts concerning an experiment in applying kerosene oil to the surface of a mosquito-breeding pool and argued from its results that in many localities where the breeding places are circumscribed, the mosquito plague may be largely averted.

The publication of this paper excited considerable interest in the subject and brought me some little correspondence from individuals who considered themselves advantageously located for the testing of the remedy on a larger scale than I had been able to attempt. Dr. Wooster Beach, of New York City, wrote last fall that it appeared to him quite possible to treat large tracks of land in the manner proposed, and solicited Government aid in locating breeding places in Westchester County along Long Island Sound, provided he could interest property holders and raise a small fund to be expended in the purchase of kerosene and the wages of men to apply it under expert supervision. The necessary aid was promised him, with Dr. Riley's sanction, and he made a strong effort to arouse the popular interest by articles in the local papers; but either through nonsusceptibility to mosquito poison on the part of his neighbors, or through indifference arising from other causes, he failed to collect the fund, and an interesting experiment on a large scale was thwarted.

Another very satisfactory experiment upon a small scale, however, has been made the present season. But before recounting the facts in the case I must advert to the chronic disinclination on the part of the property holders of a given neighborhood to admit that they are troubled by mosquitoes. I spoke in *Insect Life* last fall of a New Jersey mosquito remedy, recounting the killing by its means of seventy-five mosquitoes on the ceiling of my room in a New Jersey town, the name of which I thoughtlessly published. By the next mail, after the issue had reached that part of the country, I received letters from two residents of the town warning me that I would be mobbed by the inhabitants if I ever set foot in the place again, that is, provided my note should happen to be re-published in some more widely read journal than *Insect Life*. New Jersey and mosquitoes had been coupled in my mind since earliest boyhood, and I was totally unprepared to learn that our cultivated and refined neighbors were sensitive on the point.

However, after this experience I was not surprised to find that the gentleman who conducted the experiment which I am about to detail, desired his name, and particularly his locality, to be kept from the public eye. I may state, however, that it is within two hours' ride from the City of Washington, and that I have had an opportunity to verify the condition of affairs as reported to me.

The gentleman in question had seen in one of the newspapers some account of my Catskill Mountain experiments and wrote to me through a mutal friend in Washington for detailed advice in his own case. Correspondence elicited the fact that the mosquito supply must come from a small mill pond one-eighth of a mile from his house, from a small, marshy track above the pond, and from two horse troughs, one at his barn and the other at the roadside in front of his house. He had also a large rain-water barrel for which he immediately had a cover constructed at my advice.

The horse troughs were readily freed from "wrigglers" by using a small fine-meshed hand net every few days, and the kerosene treatment was used for the mill pond and the marsh. Estimating the surface area of the pond at 4,000 feet, he sprinkled on it 15 gallons of the cheapest kerosene. This formed a continuous layer, and remained evident to the senses, in the absence of rain, for two weeks. Three weeks after the application, which was made on the 4th of June, I visited the place and found that the kerosene was still operative, although a slight shower had fallen on the 17th day. No trace of a living aquatic larva of any kind could be found, and the surface of the pond was thickly strewn with dead aerial insects, among them many female mosquitoes.

A few straggling living mosquitoes were noticed about the house the first week in June, but none subsequently, and although the treatment was not repeated, none have been reported to have appeared during July.

The small marsh pools above the dam were treated at the same time, two gallons of kerosene being used for this purpose. The ensuing drought, however, dried these pools up thoroughly and vitiated the experiment. The total expense of the treatment was $1.70 plus two hours light labor for two men, and the result was immunity from mosquitoes for the household and vicinity.

This is a typical case of those which I had in mind when I expressed last year the opinion that there must be many localities where, by use of these simple remedies, the mosquito plague may be averted.

It may be well to add I had the pleasure of receiving, in May last, a note from Dr. Robert H. Lamborn, the donor of the mosquito essay prizes of two years ago, in which he says: "Your exact observation regarding the treatment of insect-breeding waters with petroleum is most useful and it seems to me to be new." I trust it is understood that no novelty is claimed for the idea, but that I have simply recorded these experiences as showing conclusively that the remedy is not a theoretical but a practical one.

Mr. Smith had known of two recent cases of the use of coal oil for destroying mosquitoes on Long Island, and stated that the results supported Mr. Howard's claims for the method.

Mr. Webster thought that the matter needed more experiment; that there was a prevalent opinion that mosquito larvæ in ponds appropriated a good deal of organic matter that would otherwise become offensive, and by destroying them it was possible to do harm instead of good.

The Secretary read a paper by Dr. Ritsema Bos. on "*Phytomyza affinis* Fall. as a Cause of Decay in Clematis." The larva of this little fly he had found to produce a disease spot on the stem a little above the level of the ground, causing the subsequent drying up of the stem. He found two generations of the fly each year, and advised the cutting off and burning of decaying stalks in early summer. Messrs. Hopkins and Garman reported similiar appearances in potato stalks and the terminal twigs of apple, which were probably due to a closely allied insect.

FARM PRACTICE AND FERTILIZERS AS INSECTICIDES.

By John B. Smith, Sc.D., New Brunswick, N. J.

It is safe, I think, to assume that every economic entomologist has been at times woefully disappointed at the outcome of what seemed the most promising experiments. Most of us have learned by sad experience that because a poison, or one used as such, acts well in one instance we can not be at all certain that it will act equally well in another. Many of us have run across insects that seem to eat all our usual insecticides with perfect impunity, or upon whom they act so slowly that they are practically of no effect. I have in mind at present, from my own experience, the Rose chafer, *Macrodactylus subspinosus* (Fig. 34) of which many farmers claim, from experiment, that the arsenites do not injure it. I am not quite ready to agree to this, but I am certain that they act so slowly as to be useless.

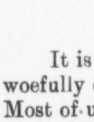

Fig. 34.

Frequently we find insects whose life habits are such that we cannot reach them with insecticides, even if we have such as would readily kill them. Of such a nature is the "Boll" or "Corn worm," the larva of *Heliothis armiger*, which in tomatoes lives in the fruit, and in corn lives in the ear; in both cases safe from any application we can make. We have next a series of forms which in their injurious stage live in the soil itself and feed upon the roots of our crops. In cases such as I have mentioned our battery of poison is of little or no avail, because there is no proper opportnity to make use of it. We must adopt other tactics and, if possible, use preventive measures. These may be either positive, as where we cover a tree trunk with a substance mechanically protecting it from injury; or they may be more indirect, as when we change a crop, or plant late, or early, to avoid the period at which injury is done. This latter means of prevention is one which, in my opinion, is worthy of the closest attention and consideration on the part of entomologists. Not the mere planting early or late, but the question of so arranging farm practice as to avoid insect injury to the important crop. Insects have a life history which in the vast majority of cases is practically invariable. There is, usually, a fairly well-marked date of appearance, a tolerably defined period of adult life, and a normal period of development. The first and most important problem to be solved is the exact life history of the injurious species. That done, before the matter of insecticides is to be considered at all, the question should be: Can we avoid trouble or injury by modifying our practice without impairing quantity, quality, or price of crop? In many more cases then is usually believed a mere change of time will avoid injury. I do not claim any originality in this suggestion, and need only instance the fact that by a proper attention to the date of sowing, damage from the Hessian fly may be avoided.

Rotation of crops, if intelligently practised, will frequently prevent trouble when insecticides are out of the question. Our fellow member, Mr. Webster, applied this principle in dealing with the *Diabrotica longicornis*, easily controlling what threatened at one time to become a very serious pest. Trap crops, planted principally to save the more important staple, are often available. For instance a full crop of late squashes may be obtained, free from the borer, *Melittia ceto*, if summer squashes are first planted and the Hubbards and Marrowfats somewhat delayed. The summer squashes will attract the vastly greatest percentage of moths to oviposition, and these may be removed after getting an early crop, filled with the larvæ that would otherwise have attacked the later vines. The proposition to use corn as a trap crop to prevent injury from the Boll worm to cotton has been forcibly urged by Mr. Mally in a recent bulletin from Dr. Riley's office. Methods of cultivation are frequently of use—as for instances in squashes again, where borers attack the vines near the roots. In fertile soil the joints may be covered at intervals and roots will be formed at every such joint sufficient to mature the fruit, even if entirely cut off from the original base of supplies. I have mentioned only a few instances to illustrate the suggestions made, and make no claim to originality so far as the principles involved are concerned. All have been applied by no means as often as they might have been, but

more often by far than the cases cited by me. The importance of fall plowing to destroy forms hibernating in the soil is not even suspected by many of our farmers, but need not be dwelt upon here.

In one other way much may be done to check many forms of destructive insect life—the scientific application of chemical manures, or fertilizers.

In the older States the natural fertility of the soil has long been exhausted, and it is necessary to supply the necessary plant food in some form. The traditional fertilizer is barnyard manure, and to this a very large proportion of the farmers cling as the only true material. Scientific experiments and investigations have shown that the necessary elements of plant food can be as well or better furnished in the shape of inorganic substances, and that they possess in many directions points of superiority over the traditional barnyard manure. In New Jersey the use of these chemical or "artificial" fertilizers or manures is annually increasing, and many of our best truckers, those that actually make farming pay, use nothing else. Merely as an instance of the result it may be recorded that the finest strawberries shown in Chicago this year were from New Jersey and were grown with chemical fertilizers only.

It occurred to me, some years ago, when I noted that farms where these chemicals were used were unusually free from insects, that they might have insecticide properties that could be very usefully employed. Peach orchards were then suffering quite severely from the *Aphis persicæ-niger*, which sapped the roots, especially of small and nursery trees, and my first experiments were directed to the question of the effect of kainit and muriate of potash on plant lice. I found them sufficiently effective to risk recommending them for use, particularly the kainit. Since that time almost every large grower of peaches in the State has dosed his infested trees with kainit, and I have not yet found an instance of failure where it was intelligently applied. How far stupidity can go is shown by a grower who carefully piled little hills of this material around his nursery trees, to make certain it should all get to the roots. He lost almost every one of his trees, though the application, if broadcasted, would have been considered a moderate one only. Of course the potash acted as a stimulant and supplied needed plant food; but even though part of the improvement was explainable in this way in some cases, yet it really made very little difference so long as the primary object, the destruction of the Aphids, is concerned.

In some sections of New Jersey the Corn Web-worm has become somewhat troublesome of late years, and in this season of 1893 is worse than ever before. I have inquired and examined carefully in a number of cases, and in every case I found that where chemical manures were used injury was insignificant or entirely wanting, while in many other fields in which old methods were employed no stand was obtained after two or even three replantings, and the fields loooked excessively ragged and uneven. In one of the bulletins of the Delaware Experiment Station this fact is quite evidently brought out, though not aimed at in the experiment made. Muriate of potash is less effective than kainit, but has very decided insecticide value. Nitrate of soda ranks close to kainit in effectiveness, and is peculiarly valuable as a fertilizer from the rapidity with which it becomes available as plant food, strengthening and stimulating growth as well as destroying insects. I have had opportunities several times this year to note wire-worm injury on farms treated by chemical fertilizers as compared with those on which the usual routine was followed, and the verdict was always and vastly in favor of the chemical manures. No insects can live for any lengthy time in a soil saturated with these fertilizers, and I have tried all forms that have come under my notice. Mr. Fletcher found white hellebore very effective against the cabbage maggot; tried on a maggot that is found in diseased onions, hellebore was far inferior in its action to kainit or nitrate of potash. Truckers using these materials constantly are a unit in claiming practical exemption from cut-worm injury, which is often very severe on plant crops.

I have no desire to present statistics on this subject; these I will reserve for another occasion; my object will be gained by the few citations that have been made and which are examples of those upon which I base my faith that the intelligent use of fertilizers will be of very great aid in eventually freeing us from the injuries of many troublesome species.

This, combined with other intelligent farm practice will, I think, prove the main reliance of the farmer in future. Insecticides will and must continue to be used in some cases ; but in my opinion they have been sometimes relied upon to the exclusion of more radical measures.

The strength at which a substance proves effective, and its action on the plant, are matters of importance. Two hundred pounds of nitrate of soda and 600 pounds of kainit are not unusually large applications, and calculating this amount to onion rows I found that to make a thorough application I must use the nitrate at the rate of $5\frac{1}{3}$ ounces to 1 gallon of water, and kainit, 1 pound to 1 gallon. I made certain that these were effective insecticide mixtures, and then had one of our leading onion-growers try them over onion rows. They did not injure the plants in the least, either as to leaf or bulb, and as 10-foot rows were treated, injury would have been quickly noticed. Even the tender foliage of the rose will stand a solution of kainit at the rate of 8 ounces in 1 gallon.

As a matter of fact the solutions which come into contact with the insects are often saturated, and much stronger than the mixture given, for if the material is broadcasted or sown in the rows, each drop of water carries with it all that it can dissolve, and as the moisture evaporates, the mixture becomes just as strong as it is possible to be, and of course the insecticide effect is intensified.

I will close by simply referring to the fact that the phospates have no insecticide value so far as my experience has gone—not even the odorless phosphate, which has been put upon the market with the usual nostrum circular claiming that it would kill everything.

This paper was discussed by Messrs. Hopkins and Webster.

Mr. Hopkins thought it was a question as to whether the fertilizers really kill insects, or by giving plants increased vigour enable them to outgrow injures. He had observed in his practice on the farm that the use of stable manure on sod infested with white grubs and wire-worms had the effect or producing a good crop of corn when plowed under, while on adjoining land not fertilized, the attack of these insects was very destructive.

Mr. Webster had no doubt that fertilizers increased the vigor of plants, but thought that Mr. Smith had not demonstrated that they destroyed or drove away the insects.

The above papers were all read at the first session of the Association on the afternoon of August 14th. At the second session on the morning of the 15th letters were read from certain foreign entomologists regretting their inability to attend the meeting.

Mr. Garman presented a paper on the "Preservation of Larvæ for Study." He drops the larva into water heated to the boiling point, leaving it for 15 seconds. Then, when the body wall is somewhat rigid, he takes it up with the forceps and with a fine sharp scissors cuts a slit along the underside of the body, dropping it into the water for a few seconds longer. It is then transferred to 50 per cent. alcohol and in 12 hours to 70 per cent., and in 12 hours afterwards to 95 per cent. for permanent preservation. Shape, colours and structure are well preserved in this way. As a substitute for alcohol he recommends : boiling water, 250 cc. ; common salt, 3 tea-spoonfuls ; powdered alum, one teaspoonful; pure carbolic acid, 5 drops ; filter.

Mr. Forbes spoke of the preservation of fruits at the World's Fair and suggested that plants injured by insects may be preserved in the same way. Mr. Summers had found nothing which would satisfactorily preserve fruits. Mr. Osborn thought that aqueous preparations would freeze. Mr. Smith has employed with success methods similar to those of Mr. Garman.

A paper by Mr. Cockerell entitled, "The Distribution of Coccidæ," was read by the Secretary. He compared the Coccidae of the different West India Islands with the adjoining mainland, and spoke of the further distribution of a number of species which he had studied in Jamaica. Of 18 species found on that Island all but 3 are known elsewhere, and 11 have been detected outside of neotropical regions.

Mr. Hopkins presented his views on "Note and Record-keeping for the Economic Entomologist." He described the system which he has worked out and adopted and which

he has proved to be well adapted to the requirements of his work. The system consists of an accession catalogue and a species catalogue. Specimens of his cards or note pads were exhibited, and Messrs Smith, Osborn and Webster discussed the paper,—Mr. Webster giving in full his own system of note-keeping. Messrs. Smith and Osborn objected to the use of check-list numbers alone for species as adopted by Mr. Hopkins.

Mr. Garman's paper on "Illustrations for the Economic Entomologist" was next presented. He considers that the object of illustrations is to convey information and to save time in description, finish and technique, being, therefore, matters of secondary importance. The different methods of reproducing drawings were very carefully and fully discussed. Etching was considered in general impracticable as calling for a special method of drawing. Lithography was considered too expensive and wood-engraving is subject to liability of the engraver to misinterpret certain details of the drawing; but at the same time it was admitted that of our published figures, wood-cuts are the best. In spite of its disadvantages it is the most satisfactory method, although somewhat expensive. Cheap process figures are excellent for newspaper and other transient literature. Their right in permanent literature and especially in scientific writings is questionable at the present time. No cheap process known to the writer gives good results in shaded figures. These figures give promise of something better in the near future. If it were not, however, for this hopeful outlook it would be well to return to wood-engraving. Entomologists were urged to make their drawings with extreme care and to adapt them to a particular process and not to rest satisfied with inferior reproduction. The paper was discussed by Messrs. Osborn, Weed, Smith, Hopkins, Gillette, Forbes and Howard

Mr. Gillette read a paper on "The Arsenites and Arsenical Mixtures as Insecticides." The article comprised a general summary, historical and critical, of the use of these substances in their different combinations. The paper was discussed briefly by Messrs. Beal, Wood and Galloway, all of whom were present at the meeting, although not members of the Association.

Upon invitation, Mr. B. T. Galloway, Chief of the Division of Vegetable Pathology, of the U. S. Departmnet of Agriculture, gave a short account of some recent work done in his Division upon a bacterial disease of melons and other cucurbits which had been found to be largely disseminated by the agency of insects, particularly of *Diabrotica vittata* and *D. 12-punctata*. Messrs. Webster, Smith and Garman had seen the same disease in their respective localities.

At the third session, held in the afternoon of August 15th, an amendment to the constitution was adopted, levying annual dues of 50 cents upon each member of the Association, and a resolution was passed authorizing the publication of the whole proceedings in *Insect Life* and the sending of an abstract to the *Canadian Entomologist*.

Messrs. Osborn, Webster and Weed were appointed a committee on nomination of officers. The following paper was then read :

DESTRUCTIVE SCOLYTIDS AND THEIR IMPORTED ENEMY.

By A. D. Hopkins, Morgantown, W. Va.

Within the last three years enough evidence has come under my observation of the destructive powers of Scolytid bark and timber beetles to convince me that they are among the worst enemies of our forest trees. In fact it is my belief that bark and timber beetles have caused the loss of more property, having a commercial value in West Virginia, within the last ten years, than that occasioned by any other single class of insects within the same time.

The destruction of our pine and spruce forests alone, resulting from the primary attack of a single species of bark beetle, has caused, since 1890, the loss of timber having a value of not less than a million and a half dollars.

Certain great devastations in the spruce forests of Maine, New Hampshire, New York, New Brunswick, France and Germany, since 1860, were evidently the work of

bark beetles, which, aided by timber beetles, not only cause the death of trees, but so damage the wood and hasten its decay that the timber soon becomes worthless, and in this country proves almost a total loss.

The destructive species of Scolytids may be divided into two classes, one class, including only a limited number, makes the primary attack, or prefers to enter the bark, roots and wood of living trees and other plants. The other class has a preference for injured, unhealthy, or felled trees, etc., the bark and wood of which these insects infest for the purpose of perpetuating their species. The first is primarily to blame for causing the death of trees, or at least a diseased condition, while the second is responsible for the death of the diseased ones and for causing the premature decay of the wood. All bark and timber beetles are, therefore, more or less destructive in their habits, their power of destruction depending more than anything else perhaps upon their numbers.

Nature has provided plant life with the power, to a certain extent, of resisting the attack of enemies and with natural means of healing wounds, recovering from disease, and other injuries occasioned by severe drought, cold, etc. Therefore, in order for a single species of insect enemy of a tree to attack and kill it, it must not only infest a vital part, but must occur in sufficient numbers to overcome all resistance. This is especially the case with destructive Scolytids, which, to accomplish this end, must enter the bark or wood of living trees, where they meet with the flowing sap, which offers the greatest resistance and is most difficult to overcome. Therefore, no single species of Scolytid bark beetle can cause the death of large or small forest trees unless occurring in immense swarms. In fact, it is doubtful if any single species could overcome the resistance thus offered by vigorous, healthy trees, without the assistance of numerous species of Scolytids and other insects which always come as reënforcements after the first attack is made. Hence, to cause a widespread devastation of timber, numerous species must work in concert. One species makes the primary attack and causes at once an unhealthy condition of the bark and tree. This diseased condition, if ever so slight, attracts other species to the affected tree. One or more kinds will attack the bark and wood at the base, others attack the bark at different points on the trunk, others infest the large and small branches, while still others enter the bark and wood of the terminal twigs, until the infested trees may be the hosts of twenty-five to forty species of Scolytids, each aiding the other in making the conditions favorable for the perpetuation of their species, and all contributing to the death and premature decay of their host.

Thus, through certain favorable conditions (the increased numbers of the species which are capable of existing in the green bark of living trees being the most favorable), an invasion may be started which in a few years results in the loss of millions of dollars worth of property.

The fact that the primary attack of one species makes the conditions favorable for the increase of others, which in turn contribute to the increase of the first, is an important feature to be considered, in our effort to discover methods of checking or preventing the ravages of this class of insects. If the number of those making the primary attack can be reduced below their power of causing a diseased condition of the trees, the trouble of which they are the primary cause must end. If, on the other hand, their undue increase can be prevented, invasions by them can not occur.

Thus, it is evident that, before considering a remedy against an invasion of Scolytids, we must discover the species to blame for the primary attack, and become as familiar as possible with its life history and habits, as well as the life history and habits of other species co-operating with it, and also study other causes which might contribute to or oppose the progress of their destructive work.

In the consideration of preventive measures against invasions of Scolytids, we must study the habits of the different species of the family in order to ascertain which of them are capable of causing diseased conditions of trees, or through increased numbers, their death.

During an investigation of serious trouble caused by these insects in our state, I have given special attention to these subjects. After discovering the species to blame for the

primary attack, and its principal aids in continuing the devastations, methods of checking the increase of the destructive kinds and protecting forests of healthy timber from their invasions were considered.

I was convinced from the first that no artificial remedy, such as cutting and burning the infested trees, the removal of the bark from the trunks, etc., could be successfully applied in our West Virginia forests. Therefore, my attention was turned toward the study of the parasitic and predaceous enemies of Scolytids, with a view of ascertaining the most desirable kinds with which to conduct experiments in utilizing them as a means of checking the increase of the destructive species.

An enemy of Scolytids was desired which would not have to depend on one or two species for its existence, but could readily adapt itself to different species and to varying conditions.

I found that while Scolytid bark beetles have numerous parasitic Chalcid, and Braconid enemies, few, if any of them, in my opinion, can be relied upon as introduced enemies to suppress or prevent an invasion of these beetles. I found, however, among their predaceous enemies, that the habits of certain species of the Coleopterous family Cleridæ were such, if these beetles occurred, or could be introduced in sufficient numbers in the infested forests, this would certainly have the desired effect.

In my search for literature regarding native and European Clerids, I found, in a report upon forestry, by F. B. Hough, 1882 (p. 264) as copied from a special publication of the French Forestry Administra, in connection with the Universal Exposition at Paris, that a European species, *Tillus formicarius*, was mentioned as being a "foe of *Bostrichus typographus* that pursued them without mercy," during an invasion of these bark beetles in the forest of *Abies excelsa* in the Jura mountains, from 1868 to 1872. This led me to make further inquiries in regard to this and other European enemies of Scolytids, and on October 13, 1891, I wrote to my correspondent, Oberfoerster W. Eichhoff, of Strasburg, Germany, asking him to send me some pinned specimens of insects known to be special enemies of European Scolytids. At the same time I indicated to him my desire to introduce live examples of such species as in his judgment would prove beneficial in this country as natural enemies of *Scolytus rugulosus*, *Polygraphus rufipennis*, *Dendroctonus terebrans*, and *Dendroctonus frontalis*. Among the thirty one species of pinned specimens received from him on November 12, he mentioned *Clerus formicarius* as being "beyond a doubt the best destroyer of Scolytids."

On May 30, 1892, I again wrote to Mr. Eichhoff, mentioning the damage to our forests by *Dendroctonus frontalis*, and stated that I was very anxious to try the experiment of introducing *Clerus formicarius* into our forests as an enemy of this and other bark beetles. In his reply of June 26, he referred me to Director C. Schaufuss, of the museum at Meissen, Saxony, as one who could give me efficient aid in this matter. Upon further investigations of the ravages of the bark beetles in our forests, I prepared a special report, dated July 9, which was addressed to the principal owners of the spruce and white pine timber in West Virginia. In the closing paragraph of this report, reference was made to the successful introduction of the Vedalia into California, and the possibility of introducing in a like manner insects from Europe which would feed upon the destructive bark beetle. It was suggested that it might be necessary to make a special trip to France and Germany for this purpose, and that if the timber interests of the State would share in the expenses of such a venture, this object might be speedily accomplished. In reply to this communication six of the principal timber companies of the State responded with liberal contributions, and I was authorized to proceed at once to Europe for the purpose of studying the insect enemies of European Scolytids, and to collect and import to this country such species as in my judgment would prove efficient in checking the ravages of insects in our forests.

In studying the enemies of European Scolytids, I found, as in this country, numerous Hymenopterous and Coleopterous parasitic and predaceous species in company with the Scolytids in the bark of the infested trees, but realizing to the fullest extent the danger of introducing insects into this country which might prove injurious as well as beneficial, I took every precaution in the selection of the species. Out of quite a number of enemies of Scolytids observed and considered, only one, *Clerus formicarius*, was selected, primarily

on account of its being regarded as the greatest destroyer of European bark beetles; secondarily on account of the general opinion of entomologists and forest officials whom I consulted, and my own convictions from a personal study of its habits, that it would not be injurious.

The first examples of this European bark beetle destroyer collected by me were taken in the Hagenau forests of *Pinus sylvestris*, on August 29, in the first tree examined, and they were afterwards found common in the larva, pupa, and imago stages in their pupa cases or winter quarters in the outer bark of large and small trees which had been injured or broken by storm and heavy snow. The bark of these injured trees was infested principally by the common European bark beetles, *Hylesinus* (*Myelophilus*) *minor*, Hart., and *Hylesinus* (*Myelophilus*) *piniperda*, Linn. The larva of the Clerid had evidently been devouring the larvæ and pupæ of the latter species at a fearful rate, for in many instances scarcely one had escaped where there had apparently been thousands. The Clerid was also found under the same conditions in the forests near Meissen in the Kingdom of Saxony, and was taken from the bark of spruce logs in the Lauterbrunnen Valley in Switzerland, where they had been feeding on *Tomicus cembrae*, Heer.

Upon my return to this country, with something over a thousand specimens, a small colony of the beetles and larvæ were placed in a pine woods near Morgantown, on October 10, 1892, being the first examples set free in America. The remainder were successfully kept over winter in the larval and pupal stages, and between April 20 and May 10, they were distributed to the timber companies which had contributed to the expenses. Colonies of 25 to 100 were placed by me, or under my special supervision, on and in the bark of trees, logs and tops, where the conditions were most favorable for their propagation.

Eight importations, numbering 2,082 examples, have since been received from collectors in Alsace and Saxony, Germany, and the living examples have been sent to the timber companies in five different counties, with special instructions for their proper location in colonies in the same manner as first mentioned. In all 26 colonies have been placed in the different sections of our forests. The conditions surrounding each colony are most favorable for the Clerids to thrive and increase, and we have every reason to believe that they will do so under their changed conditions, but as yet we have no means of ascertaining to what extent they have multiplied, and, of course, it is too early to expect results.

There is one interesting fact, however, that I have observed this season regarding the destructive Pine bark-beetle, *Dendroctonus frontalis*, and that is that its numbers have been very greatly reduced since last fall, consequently at this time very little, if any, timber, is dying.

On the 24th of July, 1892, I found this species attacking and mining beneath the bark of living trees, in which they occurred in immense numbers. By the latter part of September a brood had emerged from the bark of the same tree while the leaves were yet green and those that had emerged were entering the bark of other living trees. In November the bark of the same trees were found to be infested by countless thousands of the insects in all stages from eggs to adults. Trees so affected subsequently died, but through persistent search in the bark of such trees in different sections of the State, I have failed, as yet this season, to find a single living example of *Dendroctonus frontalis*. Hence the trouble, as caused by this species, is evidently at an end in West Virgina, for the present at least.

No other species of Scolytids infesting the same trees seem to have been affected by the cause which it would seem has rendered *Dendroctonus frontalis* almost extinct. In fact the great number of trees that died last summer and fall were found last spring to be infested by immense numbers of bark and timber beetles of different species. These have since emerged, and it would seem that the only danger to be apprehended from a continuation of a trouble like that we have mentioned, would be from the attack of some of the species which have thus emerged from the dead trees, for it is evident that unless they find favorable conditions in the felled trees, tops, stumps, etc., in lumbering regions they must either attack and kill living trees or they must perish.

One species, the Turpentine Bark-beetle, *Dendroctonus terebrans*, has already made a desperate effort in this direction. Early in May the adults emerged from the trees in which they had bred, but failed to find dying trees, the bark of which they preferred to in-

fest for the purpose of depositing their eggs. Then followed a remarkable and interesting occurrence, probably never before observed in the life habits of this and other species of Scolytids. They with numerous other members of the Scolytid family, including both bark and timber beetles, must have started, with one accord, in search of more favorable conditions for their propagation, for they occurred in different sections of the State, at about the same time, in great swarms like migrating locusts. Specimens were sent to us accompanied by startling accounts of plagues of bugs that invaded mill yards, furniture shops, newly painted houses, etc. They were reported as coming like a hailstorm against the windows, and in at the open doors like swarms of bees, and that the air on all sides was full of them. During my absence from Morgantown (where our station is located) one of these migrating swarms of Scolytids invaded the town and occurred at certain houses and at furniture factories in such immense numbers that some of the people became alarmed. The report was started that Hopkins' German bugs had devoured all of the pine bugs and were going to prove like the English Sparrow, a universal pest. It was probably well for me that I was absent at the time.

The men were painting a new greenhouse at the station at the time, and the number of the beetles attracted to the building, evidently by the odor of turpentine, was so great that the men were exceedingly annoyed in their work. When I returned to the station, several days after, I found evidence of their numbers in the handfuls of dead beetles that failed to escape from the greenhouse.

Dendroctonus terebrans occurred in by far the greater numbers in these migrating swarms, and when they failed to find dying or injured trees they attacked living Pine of all kinds, Black Spruce and Norway Spruce, entering the bark at the base of the trees. Some of the trees thus attacked in May were examined July 15, and the bark near the point of the attack was found to contain parent adults, eggs, and full-grown larvæ, the larvæ occurring in great numbers surrounded by the flowing turpentine. Trees so attacked were still living, but the injury will probably cause a diseased condition of the trees, which will attract other species and result in their final death, thus we may be on the eve of a new destructive invasion like that which has just passed. Other species, like *Polygraphus rufipennis*, *Tomicus calligraphus*, and *Tomicus cacographus*, which are capable of existing in green, sappy bark, occurred in such abundance in the dying spruce and pine trees last spring that it is evident they must exist in the forests in great numbers, and are ready to attack trees showing the slightest indication of disease or weakened vitality, if they do not make a primary attack.

Therefore, this imported enemy will find abundant food and favorable conditions for its rapid increase in the infested bark of felled trees, tops and stumps in lumbering regions in which or near which the colonies have been placed.

This imported Clerid does not confine itself to one or two species of bark beetles in one kind of trees, but the adults, it would seem, will attack and devour the adults of any species of bark and timber beetles found in the United States, and their larva will feed on the eggs, larvæ, pupæ and young beetles of any species infesting the bark of pine and spruce trees. In fact, they are inclined to make themselves generally obnoxious to the little bark pests.

It would seem that all of the conditions necessary for the imported Clerid to multiply and become an efficient protector of our pine forests from future destructive invasions of bark beetles are most favorable. *Dendroctonus frontalis*, evidently the most destructive enemy of our pine forests, has, from some cause, been reduced far beyond its destructive powers. Other species which have depended upon it for the primary attack are, it would appear, somewhat demoralized on account of the disappearance of their benefactor. The large amount of felled timber found in the several lumbering regions will probably attract the larger portion of other threatening bark beetles away from the green trees, and by the time *Denaroctonus frontalis* can again marshal sufficient forces to successfully attack and kill the trees, they will, it is hoped, be met with a force of enemies led by the European Bark-beetle Destroyer, which will successfully repel them and thus save our forests in the future from destructive invasions of bark beetles.

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Mr. Smith, in discussing this paper, said that he thought the experiment entered upon in West Virginia well conceived, but thought that parasites did not greatly benefit the farmer. Mr. Hopkins, in reply, stated that it required enormous numbers of the Scolytids to kill the pine trees, and that his idea was to get some means of reducing the numbers of the beetles and not completely exterminate them. That parasites were a benefit to agriculture was, he thought, demonstrated by the irruptions of pests which took place when, by some means, they reached localities from which their parasite was absent.

PARASITIC AND PREDACEOUS INSECTS IN APPLIED ENTOMOLOGY.

By C. V. Riley, Washington, D. C.

The importance to man, and especially to the agriculturist, of the parasitic and predaceous insect enemies of such species as injure vegetation, has been recognized by almost all writers on economic entomology. Indeed, it is a question whether the earlier writers did not attach too much importance to them ; because, while in the abstract they are all essential to keep the plant-feeding species in proper check, and without them these last would unquestionably be far more difficult to manage, yet, in the long run, our worst insect enemies are not materially affected by them, and the cases where we can artificially encourage the multiplication of the beneficial species are relatively few. While fully appreciating the importance of the subject, therefore, it is my purpose in this paper to point out the dangers and disadvantages resulting from false and exaggerated notions upon it.

There are but two methods by which these insect friends of the farmer can be effectually utilized or encouraged, as, for the most part, they perform their work unseen and unheeded by him, and are practically beyond his control. These methods consist in the intelligent protection of those species which already exist in a given locality, and in the introduction of desirable species which do not already exist there.

The first method offers comparatively few opportunities where the husbandman can accomplish much to his advantage. That a knowledge of the characteristics of these natural enemies may, in some instances, be easily given to him, and will, in such instances, prove of material value, will hardly be denied. The oft quoted experience which Dr. Asa Fitch recorded of the man who complained that his rosebushes were more seriously affected with aphides than those of his neighbors, notwithstanding he conscientiously cleaned off all the old parent bugs (he having mistaken the beneficial ladybirds for the parent aphides) may be mentioned in this connection. Other cases will recur to you, and I will mention one rather striking experience related by my assistant, Mr. L. O. Howard. The Army Worm (*Leucania unipuncta*) was overrunning a large and valuable field of timothy and threatened the destruction of the adjoining fields. The insect was as yet, however, circumscribed and susceptible of remedial treatment. The owner of the field, observing the buzzing swarms of the Red tailed Tachina-fly, assumed that the fly was the parent of the worms, and as the former was an active winged creature, capable of extended flight, he concluded that remedial work was useless, since the flies could, and doubtless would, deposit their eggs over the entire surrounding country. As a consequence the worm was allowed to travel to the adjoining fields and the injury thus increased through ignorance of the fact that the Tachina flies were the most important of the parasitic enemies of the worm. For many years well-informed gardeners in parts of Europe have practised collecting ladybirds and some of the ground beetles to liberate upon plants infested by plant-lice or by cutworms. The characteristics of these two families, Coccinellidæ, and Carabidæ, should be taught in our schools, as a definite knowledge of certain species, which is readily acquired, may often be turned to account in a limited way by the cultivator.

In a few cases like this there is no reason why the farmer should not be taught with advantage to discriminate between his friends and his foes, and to encourage the multiplication of the former ; but for the most part the nicer discriminations as to the bene-

ficial species, some of the most important of which are microscopically small, must be left to the trained entomologist. Few of the men practically engaged in agriculture and horticulture can follow the more or less technical characterizations of these beneficial species, and where the discriminating knowledge is possessed, it can, as just intimated, only exceptionally be turned to practical account. Thus our literature on this subject in the past has been of interest from the entomological rather than from the agricultural point of view, as most writers on economic entomology have contented themselves with describing and illustrating such beneficial species.

In other cases much good may be done without any special knowledge of the beneficial forms, but as a result of a knowledge of a special fact which enables the farmer to materially encourage the multiplication of parasitic species while destroying the plant-feeding host.

The Rascal Leaf-crumpler (*Mineola indiginella* Z.) a common insect which disfigures and does much damage to our apple and other fruit trees, and which hibernates in

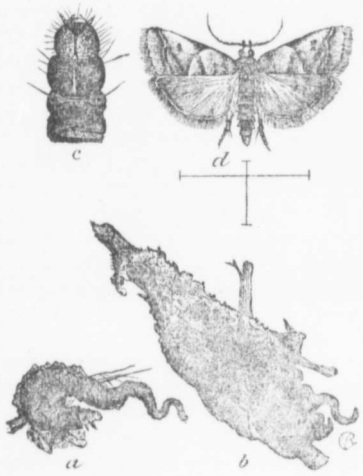

FIG. 35.

FIG. 36.

cases attached to twigs, is a case in point. (Fig. 35, *a* and *b*, represents the curious cases made by these worms; *c*, the head of a larva; *d*, the moth. Fig. 36, shows a case covered with a bunch of withered leaves.) Many years ago I urged the importance of preserving the several parasites known to prey upon it, in the following language:*

> The orchardist has but to bear in mind that it (the leaf-crumpler) is single brooded and that it passes the winter in its case, and he will understand that by collecting and destroying these cases in the dead of the year when the tree is bare, he effectually puts a stop to its increase. . . . Whether collected in winter or pulled off the trees in spring or summer, these cases should always be thrown into some small vessel and deposited in the centre of a meadow or field away from any fruit trees. Here the worms will wander about a few yards and soon die from exhaustion and want of food, while such of the parasites, hereafter mentioned, as are developed or in the pupa state will mature and eventually fly off. In this manner, as did Spartacus of old, we swell the ranks of our friends while defeating our foes.

The practical value of this suggestion was subsequently fully demonstrated, and especially by the late D. B. Weir, who, at a meeting of the Illinois Horticultural Society, as secretary of a committee appointed by said society to consider the best means of securing co-operation in the warfare against the fruit-growers' insect enemies, announced that this policy had been followed with happy results.

*Fourth Report, Insects of Missouri, 1871, p. 40.

A similar course was urged by me in the case of our common bag-worm (*Thyridopteryx ephemeræformis*) (Fig. 37.) This species, as we know, is also subject to parasites, and the bags or cases which are collected in winter, instead of being burned, should be allowed to remain until the middle of the next summer in some vessel well separated from trees and shrubs, in order that the young worms, when they hatch in spring from the eggs contained in the female bag, may perish, while the parasites develop and escape. Prof. J. H. Comstock has suggested in a similar way the placing of the hand-collected chrysalides of the imported Cabbage-worm (*Pieris rapæ*) in boxes covered with wire netting, in order to admit of the ready escape of the little Chalcid parasite (*Peteromalus puparum*) and at the same time retain such of the butterflies as may issue—a practice which had, I believe, been successfully employed in Europe. Other similar cases of this mode

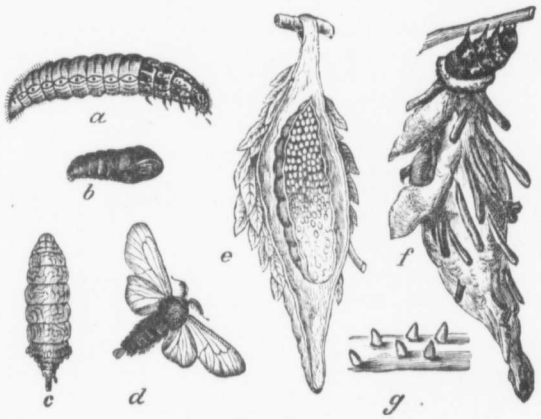

FIG. 37.

of encouragement will occur to you, but, as already stated, with comparatively few exceptions, such as those indicated, the multiplication of our parasitic and predaceous species on the line of the first method is practically beyond our control.

It is quite different in the second method of dealing with beneficial insects, for here man has an opportunity of doing some very effective work, and it is only within comparatively recent years that the importance of this particular phase of the subject has been fully realized. The Rev. C. J. S. Bethune, of Canada, was probably the first entomologist to suggest, in one of the earlier volumes of the *Canadian Farmer*, the importation of the European parasites of the Wheat Midge (*Diplosis tritici*) into America, on the supposition that this cosmopolitan species might thus be kept in check on this continent to the same extent that it was in Europe. So far ar I am aware, the attempt was never actually made, and though some subsequent correspondence was entered into between Fitch and Curtis, and later between Walsh and some of his English friends, nothing tangible resulted. The matter was, in fact, never seriously studied with this purpose in view.

The importance of this phase of the subject was early forced upon my attention, as it was upon that of others, and is frequently referred to in my earlier writings. Thus, in 1869-70, in studying the parasites of the Plum Curculio, it became evident that they were of such a nature that they could easily be trasported from one locality to another, and I distributed from Kirkwood, Mo., *Sigalphus curculionis* Fitch and *Porizon conotracheli*, Riley, to several correspondents in other parts of the State. I also urged a similar course with regard to some of the parasites of the Coccidæ, which it happens may be easily transported from one place to another in their undeveloped or adolescent stages.* Le Baron, in his studies of the Oyster-shell Bark-Louse of the Apple and one of its parasites (*Aphelinus mytilaspidis*) transported scale-covered twigs during winter from Geneva, Ill.,

* Third Rep., Ins. Mo., 1870, p. 29; Fifth Rep., do., 1873, p. 90.

to Galena, Ill., with beneficial results. The experiment was conducted on a small scale, but the parasites issued and became domiciled in their new locality, thus proving the practicability of his scheme. In neither of my experiments nor in Le Baron's, however, was sufficiently thorough examination made to prove that the parasites did not already exist in the localities in which they were colonized.

Planchon and myself introduced *Tyroglyphus phylloxeræ* from America into France in 1873,† and it became fully established, as subsequent correspondence and observation showed. In 1874 efforts were made to send over from England to New Zealand certain Aphid parasites to check the alarming increase of those plant pests there, and while I have no records at hand to show with what success, the later successful introduction of bumblebees to the latter country to fertilize the red clover is well-known history. In his report upon the parasites of Coccidæ in the Annual Report of the Department of Agriculture for 1880, Mr. Howard gave the subject some theoretical attention and elaborated upon the ease with which Coccid parasites could be transported from one part of the country to another during winter. He suggested the experiment of transporting *Dilophogaster californica* from the Pacific coast to certain of the Southeastern States, where it might be expected to prey upon certain large species of Lecanium. In 1883, after previous futile attempts by myself and Mr. Otto Lugger, and with the assistance of G. C. Bignell, Esq., of Plymouth, England, the living cocoons of *Microgaster glomeratus*, a common European parasite of *Pieris rapæ*, were successfully imported by the Department and the colonization of the species was established, not only in the District of Columbia, but in Iowa, Nebraska and Missouri, as specimens were simultaneously sent to the agents of the Division in those States. ‡ It has become so widely distributed since then as to lead to the inference that it must have been previously introduced at some other points, though the spread of an introduced species, even when introduced at a single point, is often so rapid that it surprises us, especially of a species that is winged, as evidenced by the spread of the Horn Fly (*Hæmatobia serrata*) over the whole eastern United States in about four years. Later, in 1891, with the aid of Mr. Fred. Enock, of London, a successful effort was made to introduce into this country from England an imporant Chalcid parasite of the Hessian Fly, *Entedon epigonus*, Walker, (*Semiotellus nigripes*, Lind.). The details of this experiment will be found in my published writings, especially in my report as U. S. Entomologist for 1891, and it is only necessary to state at this time that parasitized puparia of the Hessian Fly were received in large numbers and distributed to various points, and placed in the care of competent observers in Illinois, Indiana, Michigan and Canada. The results so far have not been marked, and but one positive report as to the acclimation of the parasite has been received, viz., from Prof. S. A. Forbes, of Champaign, Ill. I am of the opinion, however, that the lack of evidence from other points is due almost entirely to lack of proper examination, and I have every hope that the species will before long be found to have obtained a secure foothold at all of the several points of introduction. It is a very difficult matter to ascertain the existence of a parasite of this minute size, except when it occurs in great numbers. It requires an eye trained not only to the examination of these minute creatures, but one familiar with the allied imported species and native species. The reason for attempting the introduction of this particular species was simply that in England it was found to be far more abundant and far more beneficial than any of our native species have so far proved.

The present year I have become interested in the matter of the importation of a predaceous Noctuid (*Erastria scitula*) which preys upon the Black Scale (*Lecanium oleæ*) in south Europe and helps materially to keep it in check. With the help of Prof. H. Rouzaud, of Montpellier, France, who has studied the habits of this insect with extreme care, I hope to establish it in southern California, where the climatic conditions are sufficiently close to those of south Europe, and where the Black Scale does great damage to olive orchards, and to oleander trees, and also affects less seriously the Orange and Lemon. The Black Scale has already an important enemy in California in the shape of the Dilophogaster above mentioned, but the latter is only two-brooded, and the scale insect, multiplying more rapidly, outstrips it in the race for maturity. The Erastria, on the

† Sixth Report, Ins. Mo., 1874, p. 55.
‡ Report of the Entomologist in Rep. U. S. Dep. Agric. for 1884, p. 323.

contrary, passes through five or six generations in the course of a summer, and, as it is purely predaceous, it will, I believe, prove a most useful auxiliary against the Black Scale, especially if brought over without its parasites.

So far I have spoken only of the insects which have been imported into this country, but some effort has also been made in the opposite direction. Thus we have endeavored (and with some success) to return the service done us by sending to Australia and New Zealand some of our predatory Coleoptera, some of the Pacific coast parasites of the Codling Moth, and a species of the interesting genus Raphidia, which also preys upon the Codling Moth.

In 1887 and 1888 the now well-known importation of *Vedalia cardinalis* from Australia and New Zealand to California, to prey upon *Icerya purchasi*, was successfully carried out. The history of this striking example of the beneficial results that may, in exceptional cases, flow from intelligent effort in this direction, is now sufficiently well known to American economic entomologists; but anticipating that we shall have foreign delegates among us, and that our proceedings will be published more widely than usual, it will, perhaps, be wise to give the salient historical facts in the case, even at the risk of some repetition of what has been already published. In doing this the indulgence of the society is craved for the prominence of my own part in the work, rendered necessary by the disposition in some quarters to distort the facts.

The Fluted Scale, otherwise known as the White or Cottony-cushion Scale (*Icerya purchasi*, Maskell) Fig. 38, is one of the largest species of its family (Coccidæ), and up to 1888 had done immense injury to the orange groves and to many other trees and shrubs of Southern California. From Australia, its original home, it had been imported into New Zealand, South Africa and California, the evidence pointing to its introduction into California about 1868, and, probably, upon *Acacia latifolia*.

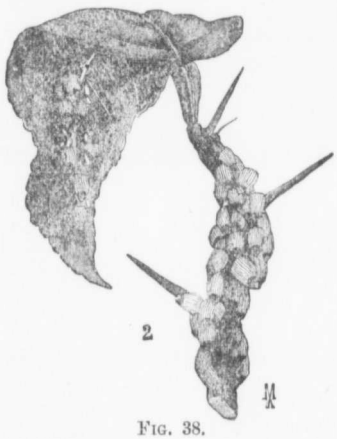

FIG. 38.

In my annual report as U. S. Entomologist for 1886, will be found a full characterization of the species in all its stages; but the three characteristics which most concern the practical man, and which make it one of the most difficult species to contend with, are its ability to survive for long periods without food, to thrive upon a great variety of plants, and to move about throughout most of its life.

The injuries of this insect, notwithstanding the efforts to check it, kept on increasing, and some ten years ago I felt that the work of this particular species and of others which seriously affected the fruit-growing interests of Southern California, justified the establishment of agencies there. Up to this time no special entomological effort had been made by the Government on behalf of the fruit-growers of the Pacific coast. Through agents stationed, the one at Los Angeles, the other at Alameda, a course of elaborate experiments was undertaken as to the best means of treating the insects affecting the Orange there, and more particularly this Fluted or Cottony-cushion Scale. During the progress of these investigations, however, the fact impressed itself upon my mind that we had here an excellent opportunity of calling to our aid its own natural enemies, for while there were some doubts as to the origin of Icerya, the question was finally settled to my own satisfaction that it was of Australian origin, and that in its native home it was not a serious pest, but was kept subdued by natural checks. These facts were not positively ascertained without a good deal of correspondence and investigation, involving, in fact, a trip to France, as has been set forth in my published writings upon the subject.

In my report as U. S. Entomologist for 1886, in an address before the State Board of Horticulture at Riverside, California, in 1887; in a paper before the Philosophical Society of Washington in the winter of 1888, and elsewhere, I urged, with all the force at my command, the advisability of endeavoring to introduce the natural enemies which

were known to keep it in check in Australia. Certain indigenous species had been discovered preying upon it in California, and I expressed the belief that, as they increased, the fruit-growers would get more and more relief from the Icerya; but I also urged that there was much more chance of success from those which keep it in check in its native home, and which were not imported with it to the countries of its introduction. The case was exceptional, and the attempt thus urged gave every promise of a rich reward. Efforts were made to introduce some of these natural enemies through correspondence, especially with the late F. S. Crawford, of Adelaide, with what ultimate results the subsequent success of Vedalia forever rendered uncertain.

The Hon. H. H. Markham, present governor of California, was at that time a Representative in Congress, and through him chiefly, but also through others, I urged upon Congress the desirability of sending some one to Australia to make a thorough study of the subject with a view of introducing those natural enemies. Again, in the winter of 1887-'88 appeals were made to Congress, not only of a personal nature, but through memorials from various societies in California, for an appropriation to send one or two men to Australia to collect and increase these natural enemies. Congress, however, failed to make any specific appropriation, and also failed to remove the restriction in the appropriation to the Division of Entomology which limited travelling expenses to the United States and prevented independent action of the Department of Agriculture. It happened, however, that about this time an appropriation was made and a commission created to represent the United States at the Melbourne Exposition, and, with the appreciative aid and sympathy of the Hon. Norman J. Colman, Commissioner of Agriculture, I took active steps to gain the co-operation of the Secretary of State in my pet scheme, and by an arrangement with the Department of State, accepted by the commissioner to said Exposition, Hon. Frank McCoppin, the Department of Agriculture was finally enabled to send to Australia two agents of the Division of Entomology, one of them to be under my instructions, and the expenses of both, within the sum of $2,000, to be paid out of the appropriation for the aforesaid Exposition.

It was thus that Mr. Albert Koebele, in the fall of 1888, was sent to Australia for this special purpose. The history of Mr. Koebele's efforts has been detailed from time to time in Government publications and in the press, especially that of California. It suffices to state that a number of living enemies, both parasitic and predaceous, were successfully imported, but that one of them, *Vedalia cardinalis*, proved so effective as to throw the others entirely into the shade and render their services really unnecessary. It has, so far, not been known to prey upon any other insect, and it breeds with surprising rapidity, occupying less than thirty days from the laying of the eggs until the adults again appear. These facts account for its exceptionally rapid work, for in point of fact, within a year and a half of its first introduction, it had practically cleared off the Fluted Scale throughout the infested region. The expressions of two well-known people may be quoted here to illustrate the general verdict. Prof. W. A. Henry, director of the Wisconsin Agriculture Experiment Station, who visited California in 1889, reported that the work of Vedalia was "the finest illustration possible of the value of the Department to give the people aid in time of distress. And the distress was very great indeed." Mr. William F. Channing, of Pasadena, son of the eminent Unitarian divine, wrote two years later:

> We owe to the Agricultural Department the rescue of our orange culture by the importation of the Australian ladybird, *Vedalia cardinalis*.
>
> The white scales were incrusting our orange trees with a hideous leprosy. They spread with wonderful rapidity and would have made citrus growth on the whole North American continent impossible within a few years. It took the Vedalia, where introduced, only a few weeks absolutely to clean out the white scale. The deliverance was more like a miracle than anything I have ever seen. In the spring of 1889 I had abandoned my young Washington navel orange trees as irrecoverable. Those same trees bore from two to three boxes of oranges apiece at the end of the season (or winter and spring of 1890). The consequence of the deliverance is that many hundreds of thousands of orange trees (navels almost exclusively) have been set out in southern California this last spring.

In other words, the victory over the scale was complete and will practically remain so. The history of the introduction of this pest, its spread for upwards of twenty years, and the discouragement which resulted, the numerous experiments which were made to overcome the insect, and its final reduction to unimportant numbers by means of an

apparently insignificant little beetle imported for the purpose from Australia will always remain one of the most interesting stories in the records of practical entomology.

The Vedalia has since been successfully colonized at the Cape of Good Hope and in Egypt, and has produced the same results in each case. In Egypt the Vedalia was introduced to prey upon an allied species of Icerya (*I. ægyptiacum*, Douglas). We hope soon to be able to send the same insect to India, where it has recently transpired that *Icerya ægyptiacum* occurs, while recent information received from Phra Suriya, royal commissioner of Siam at Chicago, would indicate that its introduction into Siam for the same or a closely allied insect will be desirable in the near future.

In fact, the success of the experiment was so striking and so important, and resulted in the saving to California of an industry of so great a money value, that it has given rise, not only in the popular mind but in the minds of a certain class of entomologists also, to the idea that remedial work against injurious insects should be concentrated upon this one line of action, and that our best hope for their destruction lies with the parasitic and predaceous species, not to mention fungus and bacterial diseases. From an extreme of comparative incredulity the farmer and fruit-grower have gone, perhaps, to the other extreme of too great faith. The case of Icerya and Vedalia, as I have frequently pointed out, was exceptional and one which can not easily be repeated.

One of the humorous phases of the Vedalia experiment is, that the wide newspaper circulation of the facts—not always most accurately set forth—has brought me communications from all parts of the world asking for supplies of the renowned little Ladybird for use against injurious insects of every kind and description, the inquiries being made, of course, under a misapprehension of the facts.

While this California experience thus affords one of the most striking illustrations of what may be accomplished under exceptional circumstances by the second method of utilizing beneficial insects, we can hardly expect to succeed in accomplishing much good in this direction without a full knowledge of all the ascertainable facts in the case and a due appreciation of the profounder laws of nature, and particularly of the interrelations of organisms. Year in and year out, with the conditions of life unchanged by man's actions, the relations between the plant-feeder and the predaceous and parasitic species of its own class remain substantially the same, whatever the fluctuations between them for any given year! This is a necessary result in the economy of nature; for the ascendency of one or the other of the opposing forces involves a corresponding fluctuation on the decreasing side, and there is a necessary relation between the plant-feeder and its enemies which, normally, must be to the slight advantage of the former and only exceptionally to the great advantage of the latter.

This law is recognized by all close students of nature, and has often been illustrated and insisted upon by entomologists in particular, as the most graphic exemplifications of it occur in insect life, in which fecundity is such that the balance is regained with marvellous rapidity, even after approximate annihilation of any particular species. But it is doubtful whether another equally logical deduction from the prevalence of this law has been sufficiently recognized by us, and this is, that our artificial insecticide methods have little or no effect upon the multiplication of an injurious species, except for the particular occasion which calls them forth, and that occasions often arise when it were wiser to refrain from the use of such insecticides and to leave the field to the parasitic and predaceous forms.

It is generally when a particular injurious insect has reached the zenith of its increase and has accomplished its greatest harm that the farmer is led to bestir himself to suppress it, and yet it is equally true that it is just at this time that nature is about to relieve him in striking the balance by checks which are violent and effective in proportion to the exceptional increase of and consequent exceptional injury done by the injurious species. Now the insecticide method of routing this last, under such circumstances, too often involves, also, the destruction of the parasitic and predaceous species, and does more harm than good. This is particularly true of those of our Coccidæ and Aphididæ and those of our Lepidopterous larvæ which have numerous natural enemies of their own class; and it not only emphasizes the importance of preventive measures, which we are all agreed to urge for other cogent reasons, and which do not to the same extent destroy the parasites,

but it affords another explanation of the reason why the fight with insecticides must be kept up year after year, and has little cumulative value.

But the problem of the wise encouragement and employment of the natural enemies of injurious insects in their own class is yet more complicated. The general laws governing the interaction of organisms are such that we can only in very exceptional cases derive benefit by interference with them. The indigenous enemies of an indigenous phytophagous species will, *cæteris paribus*, be better qualified to keep it in check than some newly introduced competitor from a foreign country, and the peculiar circumstances must decide in each case the advisability of the introduction. The multiplication of the foreigner will too often involve the decrease of some indigene. If a certain phytophage is generally disastrous in one section and innocuous in another by virtue of some particular enemy it will be safe to transfer and encourage such enemy, and this is particularly true when the phytophage is a foreigner and has been brought over without the enemy, which subdues it in its native home. Icerya had some enemies in California, presumably American, but they were not equal to the task of subduing it. Vedalia, in the Icerya's native home, Australia, was equal to the task and maintained the same superiority over all others when brought to America. The genus was new to the country and the species had exceptionally advantageous attributes. But there is very little to be hoped from the miscellaneous introduction of predaceous or parasitic insects for the suppression of a phytophage which they do not suppress in their native home or in the country from which they are brought.

The results of the introduction by Mr. A. D. Hopkins of *Clerus formicarius* to contend with the Scolytids which were ruining the West Virginia pines were doubtful, for the reason that indigenous species of the genus were already at work in America. Yet the experiment was safe and desirable, because the European Clerus is more active and more seemingly effective than our indigenes. The Gypsy Moth was evidently introduced into Massachusetts without its European natural enemies, and as in some parts of Europe it is often locally checked by such natural enemies, a great number of which are known, a proper study of them and the introduction of the most effective could result in no possible harm and might be productive of lasting good. Such a course was advised by me at a conference upon the subject held in the rooms of the State Board of Agriculture, Boston, March 4, 1891,* and in correspondence with the Secretary of the Board. In neither of these cases should we expect the predaceous or parasitic forms to subdue their hosts more effectually in America than they do in Europe, except in so far as they were relieved, in the introduction into America, of whatever enemies they possessed in their native home.

There are two other laws which it is worth while to consider in this connection. One is, that while a plant-feeder's natural enemies are apt to cause its excessive abundance to be followed by a corresponding decrease, yet this alternation of excessive abundance and excessive scarcity will often be produced irrespective of such natural checks. An injurious insect which has been on the destructive march for a period of years will often come to a sudden halt, and a period of relative, and sometimes complete, immunity from injury will follow. This may result from climatic conditions, but more often it is a consequence of disease, debility, and want of proper nutrition, which are necessary corrollaries of undue multiplication. Frequently, therefore, it may be inaccurate and misleading to attribute the disappearance of a particular injurious species to some parasitic or predaceous species which has been let loose upon it, and nothing but the most accurate observation will determine the truth in such cases. The past year furnished a very graphic illustration in point. Throughout Virginia and West Virginia, where the spruce pines have for some years suffered so severely from the destructive work of *Dendroctonus frontalis*, not a single living specimen of the beetle has been found during the present year. This has been observed by every one who has investigated the subject, and particularly by several correspondents who have written to me; by Mr. E A. Schwarz, who was commissioned to investigate the facts, and by Mr. Hopkins, who has made the study of the subject a specialty.

*Insect Life, III., p. 369, ff.

The clearest explanation of this sudden change is that the species was practically killed out by the exceptionally severe cold of last winter, since such was the case with several other insects. Now, following so closely on the introduction by Mr. Hopkins of *Clerus formicarius*, how easy it would have been to attribute the sudden decrease to the work of the introduced Clerus, had not the decrease been so general and extensive as absolutely to preclude any such possibility. In like manner a certain scale insect (*Aspidiotus tenebricosus*) had become exceedingly destructive to the soft maples in the city of Washington last year, whereas the present year it is almost entirely killed off, evidently by the same exceptional cold. Many of the affected trees were painted with whitewash, with a view of destroying the Aspidiotus, and the death of this last might have been attributed to the treatment (and naturally would be by those employing it) were it not that the same result was equally noticeable on the trees not treated. Reports from southern California would indicate that the Red Scale (*Aspidiotus aurantii*) is, in many orchards, losing its destructiveness through agencies other than its insect enemies, and in this case the facts are particularly interesting because of the ease with which its disappearance may be attributed to some of the recent introductions from Australia.

The other law that is worth considering in this connection is that experience has shown that, as a rule, the animals and plants of what is known as the Old World—*i.e.*, of Europe and Asia—when introduced into North America have shown a greater power of multiplication than the indigenous species, and in a large number of instances have taken the place of the native forms, which have not been able to compete with them in the struggle for existence. The converse proposition holds equally true, viz, that our species when taken to Europe, do not hold their own against the European indigenes. This is still more true of the species introduced from the Old World, as well as from America, into Australia, where the advantage of the introduced forms, as compared with the indigenous, has been in many cases still more marked. All other things being equal, therefore, we should expect the species which are beneficial in Australia to be less so when brought to this country, a deduction which brings out still more clearly the exceptional nature of the case of Vedalia and Icerya, just as there are some notable exceptions, as in the case of the Grape Phylloxera, in the introductions between Europe and America.

There are some instances in which there can be no doubt whatever as to the good which would flow from the introduction of beneficial species, and an illustration is afforded in the Capri-fig insect, *Blastophaga psenes*. There can be no question as to the good which would result from the introduction of this species from Smyrna into those sections of California where the Smyrna fig is grown without its intervention, and there are other similar instances which promise well and involve no risk. But I have said enough to show that the successful utilization of beneficial insects is by no means a simple matter and that discriminating knowledge is required to insure success, especially in the second category dealt with in this paper. Wherever the importance of the matter leads to legislation what are denominated "political" methods are apt either to control or in some way influence the resulting efforts—too often with unfortunate consequences. We should, as economic entomologists, be on the alert for special cases where the introduction or dissemination of beneficial species promises good results, and do our best to encourage an intelligent public appreciation of such special cases, while discouraging all that is of a sensational nature, as likely to mislead and ultimately do our profession more harm than good.

THE ECONOMIC VALUE OF PARASITES AND PREDACEOUS INSECTS.

By John B. Smith, Sc.D., New Brunswick, N.J.

At the very outset I wish to disclaim all intention either of producing a treatise on parasitism in general or disputing the importance of parasites in nature. No one can realize more than I do how much parasites maintain the balance and check the increase of injurious species. I am perfectly aware that were it not for parasites many an insect would become so abundant that certain crops could not be satisfactorily grown. Fully realizing, therefore, the place and importance of these parasites, I feel at the same time

that their economic value has been grossly over-estimated : in fact I am almost ready to say that parasites have no real economic value to the agriculturist. This sounds like a very radical statement, and perhaps I do not mean it in the fullest sense of the terms that I have used, but I would not much modify the sense of the language. The "life history" of an insect is incomplete until we know not only how it lives and upon what it feeds, how it transforms, and the duration of its various stages, but also what species prey upon it, and to which it furnishes sustenance in one or the other of its stages. We are therefore right in our studies of the "life history" of injurious insects in studying also the parasites that prey upon them. We are right also in publishing the results of our work, including the descriptions of the parasites. We are right in calling the attention of the farmer to the fact that the injurious species are very largely kept in check by either parasites or by predaceous insects ; but we are wrong in leading him to suppose that either parasites or predaceous insects will control the injurious species for him. Yet the tendency of the language used in many cases by entomologists, and more often by those who are not entomologists, has suggested the possibility that injurious species may be controlled by either parasites or natural enemies without very much work on the part of the farmer. The impression is current that it will be possible to use natural means to exterminate injurious insects, and I have been asked frequently during the past two years, by farmers who may be considered as fully equal in intelligence to the best in the land, those who read and usually understand, why I did not make some effort to cultivate or import parasites or natural enemies of our common injurious insects. Of course these questions all grow out of the remarkably successful experiment made by Dr. Riley in the importation of the Australian *Vedalia cardinalis* to exterminate the imported *Icerya purchasi*, and I have decided to bring up this subject for discussion at the present meeting in order that possibly a little more definite light can be obtained upon the exact place of parasites and predaceous insects in economic entomology. It needs no argument on my part to prove that nature never creates organisms merely to destroy others that she had previously created. Parasites do not exterminate their hosts in any instance ; their mission is merely to interpose a check to undue increase, and it is natural that this should be so, for were the host destroyed the parasite itself would perish, unless it were able to change its food and prey upon other species. It is by no means improbable that in the past certain species have been exterminated by their parasites, and, indeed, it is very probable that some such cases are in progress now. Many lepidopterous larvæ are rarely found free from parasites, and the adults are among the rarest of our species. Here we have instances where the parasite very materially lessens the number of the host and allows each year only a very few specimens to escape. It is only through the fecundity of the species that it is enabled to maintain itself at all. These cases are exceptional. Usually the relation of the parasite to its host is more moderate. Excessive increase is checked, but excessive increase only. There is always a very large proportion of larvæ and usually a comparatively small proportion of parasites. Nature tends to preserve a balance among her creatures, and a balance only. Many species which are much subject to parasites are abundant each year, and remain equally abundant from year to year, varying only very slightly, and these variations are rarely the result of an excessive increase of parasites. Nature also works very slowly, and she adapts insects as well as other animals to their environment only by means that require ages for their completion. Insects that are confined to plants which, under natural conditions are not common, need few parasites to keep them in check. The great difficulty in finding food is in itself a sufficient check, and parasites are not necessary, indeed they could not be supported under the circumstances. If, by any unnatural condition introduced by man, the supply of food for this otherwise rare insect is suddenly increased, it obtains the possibility of multiplying rapidly, while the number of parasites do not increase proportionally. In the course of time nature may make a change and other species may attack this form which has now increased abnormally ; but this is something that the farmer can not wait for ; he must have some means of dealing with the insect at once, and he must leave the operations of nature to benefit his descendants. The spread and increase of the potato beetle, *Doryphora 10-lineata*, is a case in point. Here neither parasites nor natural enemies assist the farmer in any noticeable way. He must depend upon his

own exertions to save his crop. There are however, many insects which are very commonly parasitized, and among them may be mentioned the various species of cutworms. It is nothing uncommon to find in an infested field that fully one-half, and sometimes as many as three-quarters, of the specimens will have eggs of the Tachina flies attached to the skin, and probably others have parasites which are not externally visible. Yet the fact that these cutworms are infested by parasites is of absolutely no value to the farmer. They eat just as much as if they were not parasitized, and it is really a matter of little importance to the agriculturist whether the food that is stolen from him makes a moth or a fly. The caterpillar feeds all the same until it is full grown. Next year in the same field there will just as many cutworms as there were in the previous year. The parasites have kept the number within the same limit, and the farmer has not been benefitted. If he desires to save his crop he must himself adopt measures for the destruction of these insects; parasites will not help him in the least. Let us take another instance: One of the species of Tortricids infesting the Cranberries is very subject to the attacks of parasites, two species being abundant and a third rare; yet every year the bogs suffer equally from this species. If we collect a large lot of larvæ in the early spring, we will find that very few of them will give out parasites. From the second brood we will breed a great many more, while of the third and last brood, probably seventy-five per cent. will prove to be infested by parasites. This sounds very pretty, indeed, and we say that the insect has been controlled by its parasites, and so it has; but not until it has ravaged the bogs, and has done all the injury that it could do. It has destroyed the crop, and seeing the enormous increase of the parasites during the year, the natural conclusion is, that they will next spring still further reduce the number of their host and bring matters to such a state that little or no further injury is to be apprehended. Yet, as a matter of fact, nothing of the kind occurs. We find that somehow during the winter the mortality among the parasites has been very much greater than it has been among the moths, and that just as in the previous year the first brood of moths will be almost exempt from the attacks of the parasites. We will have on the bogs exactly the same history that we found in the previous year. Of what practical benefit is this parasite to the farmer? It does not do anything in the world to prevent the destruction of his crop, nor does it any way lessen the damage, for where these insects occur and are allowed to increase without check, except by their natural enemies, they appear in sufficient numbers each year to take the entire crop. This is not a solitary instance. It can be matched with ease in all our common insects. The Codling Moth, for instance, has parasites, and is doubtless kept in some check by them; yet every one present knows that if parasites and natural enemies alone were depended upon, farmers could not count on a single perfect apple. They do check the excessive increase of the insect, but they do not lessen in the least the number that can be supported by the food plants. All the parasites that have been described from the Codling Moth, from the Plum Curculio, and any others of our injurious insects do not benefit the farmer one dollar in the value of his crops, and I think it is well that this should be generally understood, because of the tendency that I have already mentioned to expect too much from the parasites. It must be remembered also that in the operation of preserving the proper balance between life of all descriptions, nature itself has intervened to prevent the undue increase of the parasites, either by making them less fertile than the hosts upon which they prey, by giving them a smaller number of broods, or by supplying them in turn with parasites which keep them in check. This secondary parasitism is well known and it is as effective in preventing the excessive increase of the primary parasites as these are in preventing the excessive increase of the original host. There is really almost as much danger, and that is very little, that the secondary parasites will destroy the primary parasite as that the primaries will exterminate their host. Predaceous insects are in much the same case, they never entirely destroy the species they feed upon, and in 99 cases out of 100 they conquer their prey after all the injury has been done to the growing crops. Let us take the case of the Melon Louse for example. This makes its appearance in June or July, and increases with marvellous rapidity. Very soon after various species of Coccinellids make their appearance and begin preying upon the plant louse; but in the number in which they first appear they are incapable of eating up the lice as fast as they multiply. By Sep-

tember they are up with their prey, but then it is too late ; the crop has been destroyed, and although it is quite probable that the late broods have entirely rid the vines of plant lice, yet it has not benefitted the farmer one solitary cent. I had a beautiful opportunity of observing this in 1892. It was a pleasure to see how the late broods moved from vine to vine, leaving scarcely a living louse behind them ; but that same vine was dried and withered ; whatever fruit there remained on it was undersized, blackened by honey-dew, half ripe, and never in fit condition for market. Acre after acre I have seen in just that condition, and practically no revenue has been derived from the land. It is quite true that the beetles exterminated or nearly exterminated the plant lice, but this did not advantage the farmer one solitary cent. A few buckets of kerosene emulsion liberally applied early in the season, while the plant lice were running away from the lady-birds, would have been of a great deal more money benefit than all the aid that nature gave. My contention is, that in dealing with injurious insects from the farmer's standpoint, we can entirely ignore the work of parasites or predaceous insects. We must accept the fact that each year these insects will appear in about the same numbers ; that nature has evidently assumed that this is about the proper number to appear, and that all her checks are arranged accordingly. If we wish to lessen them, we must do it by means other than those which she has provided.

There is, of course, a possibility that we may in some cases make use of either parasites or predaceous insects. That has been very well illustrated by the instance before referred to, that of the Vedalia and the Icerya. The one point that is overlooked by the majority of those who see only newspaper accounts is, that we had to deal in the first place with an insect which was not a native, but which was imported. In the second place the insect preying upon it was also imported, and found as the only familiar form upon which it has been used to feed just this one species. In bringing over the Vedalia, its natural checks were not brought with it, and in liberating it in the orange groves of California, it was given an advantage that it could never have possessed in its own country. There may be a few of our insects in a somewhat similar position, and possibly some one of us may yet be as successful as Dr. Riley was in reference to some other permanently injurious species. It may even be that parasites which in their native home are not able to control or exterminate the species upon which they prey, may when introduced into this country, have such an advantage that they will accomplish more than they could in their native home. I say this may be so, but I do not anticipate it in many cases. Insects are very slow to change their habits. Just as it is rare for an American parasite to attack an imported insect in any numbers, just so rarely will we be able to induce a European or other foreign parasite to attack the American insects. We have a field here which is comparatively new, and of which we know very little, but it is not that particular field that it is my intention to enter. The propositions that I do make, and that I am ready to defend are : Among our native insects parasites act merely as a check to excessive increase. Excessive increase means more than the natural food of the insect is able to support, and does not mean excessive increase in the sense of the farmer. An insect that is, under natural conditions, abundant each year, must be dealt with without any regard to parasites or natural enemies. Other than I have just suggested, parasites and predaceous insects have absolutely no economic value.

INSECT FOES OF AMERICAN CEREAL GRAINS, WITH MEASURES FOR THEIR PREVENTION OR DESTRUCTION.

By F. M. Webster, Wooster, Ohio.

The three principal cereal grains of America north of Mexico, viz., maize, wheat and oats, cover an approximate area of from 140,000,000 to 150,000,000 acres. In other words, the natural flora over this vast territory, comprising a great variety of species, has been largely exterminated, and, instead, but three have been substituted, all of which are annuals with a capacity for reproducing each year from twenty to two thousand fold. As nature is said to abhor a vacuum, so does she resent a monopoly, except it be in cases where but few species can exist, and the increase of the individuals of these are ultimately restricted by other influences, such as a rigorous climate or a barren soil. Our grain fields include neither the barren desert, the frozen mountain tops nor the ice-clad regions of the far north, but the fertile prairies and valleys over which vegetation naturally grows in great luxuriance and profusion, each species, if left to itself, being kept in its proper numerical sphere by natural laws. The agriculturist, however, comes upon the scene and incites an insurrection, causing the three species before mentioned to not only rebel, but overrun and take possession of these broad acres, putting the original inhabitants to death and establishing themselves in nearly or quite full power. If the contest were wholly a natural one, the interlopers would soon be forced into their proper places, and exist only in proportion as they could resist the returning encroachments of the natural flora. But the plow and the hoe again interpose, and the victors still hold the field. Nature then does what is naught but good generalship, brings up her reserves in the animal and vegetable enemies of the three usurping species and precipitates them upon the foe. It is here that the hand of the husbandman seems to lose its cunning. He can fight the forests, the weeds and the grasses, but when it comes to warring upon the insects and fungoid enemies of his grains he seems to lose heart. His reserve force is, or at least should be, in his superior knowledge ; but too often this virtue seems to be either sadly aborted or entirely wanting. He does not study ways to destroy or circumvent these enemies of his crops, but, on the whole, allows them to go their way, patiently taking what they leave and hoping for better luck another year.

It is here that I wish to take up my subject and show how many of the insect foes may be either destroyed or prevented from inflicting serious injury. The field of applied entomology is not the science of killing insects, alone, but includes also the warding off of their attacks. For my own part I would reverse these terms, as it seems to me that the evasion of an attack is ordinarily the most important. I would put it in this way: Warding off the attacks of injurious species by preventing their breeding, and, in case this is not practical, destroying them either before or after the attack had begun. And I may be allowed to here make use of an oft-quoted adage, " An ounce of prevention is better than a pound of cure."

There are upwards of 140 species of insects affecting these three grain crops, and maize alone has over 100 insect foes, a number of course depredating alike upon all three. Of these, such as infest the stored grain excepted, there are very few whose attacks can not be far more easily warded off than remedied after they have begun. I know of no better insecticide than good farming, After eight years of study of the Hessian-fly (*Cecidomyia destructor*) I am satisfied that four-fifths of its injuries may be prevented by a better system of agriculture. For years I have seen wheat grown on one side of a division fence without the loss of a bushel by attack of this pest, while on the other side the crop was almost invariably more or less injured. No effect of climate, meteorological conditions, or natural enemies could have brought about such a contrast of results. The whole secret was in the management of the soil and the seeding. In fact, the question of success in evading the pest, in the one case, did not appear to be an entomological one at all ; and I am fully convinced that the Hessian-fly problem, so far as it relates to agriculture, throughout that portion of the country lying between the Alleghany Mountains and the Mississippi River, and between the Ohio River and the Great Lakes, may be considered practically solved.

Heretofore we have told people that the fly could not exist except where fall wheat was grown. But this can be said no longer, as the pest occurs in North Dakota and in a locality where fall wheat is never sown. As the fall brood of flies emerges continually earlier as we go northward, it seems to me that we must eventually reach a point where it will cease to appear in autumn at all, and go over until spring, a state of affairs that will easily account for the breeding in spring wheat in North Dakota. In other words, I expect to find that nature has protected the species alike from the protracted northern winter, and the equally prolonged southern summer, by varying its resting season with the latitude, and, possibly, also with its proximity to the seacoast. That is, we shall find the insect passing both the hot and cold seasons largely in the flaxseed stage, that being the stage of development during which it is best protected from the elements and the lack of food.

There are several good reasons why we might expect the fall brood to become extinct to the north, while the spring brood continues, the principal one being that there is not sufficient time for the former to develop before the cold season begins. Besides, in the continuity of the species it can best be spared, and I understand that it is not present in England. In nearly all cases where a species is two-brooded, the spring-appearing brood of adults is the producing while the fall is the diffusing brood. The spring-appearing flies are loth to leave the field in which they originated, and prefer to oviposit on the tillers of the wheat plant, while the autumn-appearing adults will spread out everywhere over the country, and will, seemingly, scent out a field of wheat at long distances. They can even be drawn to very small plots in the midst of large cities. With the Aphides the winged female produces fewer young, but spreads them over a larger area. In *Isosoma tritici* the spring brood of females has so far followed this rule in the past that their wings are either entirely absent or aborted, while the summer brood, *grande*, has invariably fully developed wings and is the diffusing brood. The Army Worm, *Leucania unipuncta*, is destructive through one brood only, the fall brood being far less gregarious. This is also true of the Chinch Bug, *Blissus leucopterus*, though in Northern Indiana and Northern Ohio I find the larger parts of the adults with aborted wings. The spring brood of Hessian Fly, coming as it does from plants that will continue through a sufficient season for their progeny to develop, has no need to migrate, while those that summer in the stubble must necessarily change, as the plants can furnish no further nourishment; besides, diffusion and differentiation serve in a measure, to protect from natural enemies. But, notwithstanding this, it will be easily observed that the latter brood can be best dispensed with without material and permanent injury to the species. This appears to me to be the state of affairs that we may look for. I do not wish to be understood as making the unqualified statement that these conditions do exist, and only hope that members of this association, located to the north and to the south of the area indicated, will be able to prove either the truth or fallacy of my position. We have much yet to learn in regard to this Hessian fly, and a study of it in any locality would probably develop some new features, or at least new parasites.

There are some facts connected with the two species of Isosoma, *I. tritici* and *I. hordei*, that, to me at least, are rather puzzling. Unless an undermined species, found in New York by Dr. Lintner, proves to be *tritici*, I am not aware of its occurring east of the Alleghany Mountains, though it reaches west to the Pacific coast. On the other hand I never saw *hordei* in Illinois or Indiana, nor did I find them in central Ohio, yet I had not been a week in the northern part of the latter State before I found them in abundance. They occur, generally, over the north portion of the State and into Michigan. Is it not possible that *hordei* is of northern origin, where the season is too short for two broods, while *tritici* has pushed up from the south, where the protracted vernal season is favorable for the development of two broods? I find that the *hordei* almost invariably selects small wheat plants in which to oviposit, while the summer brood of *tritici* as invariably selects large, thrifty stalks, usually where the plants are thin on the ground but rank growing. In northern Ohio I never find *hordei* far below the upper joint, an exceptional feature I believe, though it seems to me we might look for such a state of affairs, as it oviposits during a season intervening between the spring and summer broods

of *tritici*. Then, too, I notice the parasites of *hordei*, at least *Eupelmus allynii*, French, *Semiotellus chalcidiphagus*, Walsh, and *Websterellus tritici*, Ashmead, emerge in August and oviposit in the same straws from which they themselves emerged, the adults from these emerging in spring. I have also noted the same thing in the two former species where their host was the Hessian Fly. In both cases, however, I got fewer parasites in spring than in August.

So far as measures for their control are concerned, *tritici* can be largely overcome by a rotation of crop, while both this and *hordei* will be destroyed by burning the stubble, a measure equally applicable to the Hessian Fly and Wheat Stem-maggot, *Meromyza americana*. In some portions of the country, however, clover is sown among the young wheat in early spring, and a burning over in summer under such conditions is impracticable.

I wish to call attention to a few points in reference to the Chinch Bug, *Blissus leucopterus*. The area of extreme continued injury by this pest covers southern Minnesota, southeast South Dakota, much of Nebraska and Kansas, all of Iowa, and much of Missouri, Illinois, all of Indiana except northeastern portion, extreme southwest Ohio, and northern Kentucky, though in the wheat region of the Mississippi Valley the pest is by no means limited to this area, nor does it confine itself to the wheat region at all.

They are more abundant in Louisiana, where wheat is never cultivated, than they are in northern Ohio, where this cereal is one-half of the grain crop. When they were working their greatest havoc in southern and central Illinois and southwest Indiana I looked in vain for them in northern Indiana. I do not understand why it is that a very large per cent. of the adults found in Ohio, along Lake Erie, and in northern Indiana possess only aborted wings; yet I have found this to be the case. As you all know, the insect parasites of this species are very few and of little account in holding it in check. For aid in this direction we must look to the meteorological conditions unfavorable to their increase and fungoid and bacterial parasites. These last will be found available during some seasons and within a certain limit, but nature is not likely to use one of her servants to annihilate another. We may be able to emphasize their work in this direction by continual artificial cultivation and distribution; further than this we can not expect to go, and the relief will at best be but local and temporary, though not by any means without value in limited areas. The only difficulty is that we, with certainty, can not foretell a year of destructive abundance, and a few false alarms will so discourage the ordinary farmer that he will do nothing to protect himself. For my own part I feel quite sure that if the bugs can be induced to oviposit in spring in small plots of Millet or Hungarian grass, they can be controlled by the use of these vegetal diseases to far better purpose than to attempt to do so in the fields of ordinary cultivation. But there must be, somewhere, a central source of supply where requests for material can be promptly filled, as has been done by Prof. Snow, before the plan will prove a success. Next in value to such plats is, I think, the cornfields where the young bugs must of necessity congregate in compact masses and thus facilitate contagion.

It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the Apple during the winter season. I refer to the Apple Leaf-louse, *Aphis mali*, Fab. Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils this extraction of the sap from the roots has no very serious effect, but where the soil is not rich, and especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the Aphis abandons them, in autumn to return to the Apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn, and the result must be to reduce their productiveness the following year.

The greater number of serious pests of our fields of Indian corn are such as work to their injury below the surface of the ground. The larvæ of Elaters devastate our lowlands and the grubs of Lachnosterna ravage the higher lands, while Cutworms, Web

Worms, and Corn-Root-worms are found generally diffused over both. The Corn-Root-worm, *Diabrotica longicornis*, excepted, all of these seem more destructive to a crop of grain following a grass crop or pasture. Yet this is not always true. I have known of fields of corn being seriously affected by white grubs when such fields had not been devoted to grass for a single season in twenty years.

In the case of Wire Worms some good results may be secured by fall plowing, though as the adults emerge in August or September, and winter over also in this stage, we can hope to do little with these. There are, however, during the winter two young generations in the soil, and against these a fall plowing may and evidently does have an ill effect. What a summer fallow would do I have had no opportunity of learning. There are no end of reported successes and failures among farmers, but there is so much obscurity shrouding these that one cannot judge of their authenticity. Once and once only, have I felt quite sure of having beaten these pests. This was in the case of a field of grass land, plowed in spring and planted with potatoes. The worms nearly ruined the crop, and in the fall the ground was still well populated with them. The following spring potatoes that had escaped notice when the crop was harvested seemed to attract the worms, and the latter were found burrowing in the tubers in great numbers. On my suggestion, hogs were turned into the field, and these rooted out and promptly disposed of both potatoes and worms, no injury occurring to the following crop, which was of corn. There may be some virtue in the application of kainit, although this has not as yet been thoroughly and clearly demonstrated, and, besides, over the vast corn belt of the Northwest, its application is impracticable. For myself, I am willing to confess ignorance of any unfailing, practical measure, either of prevention or destruction. Fall plowing and a rapid rotation of crops are as yet the best measures we can recommend.

White Grubs, the larvæ of several of our species of Lachnosterna, appear to give preference to the higher lands. Where the soil of such lands is of such a nature as to wash easily during winter and spring, fall plowing results in the washing out of great gullies, thus constituting a grave objection to the measure. Outbreaks of this pest seem to be usually of triennial occurrence, different localities being affected during different years, and I have thought we might accomplish something by mapping out these areas, and so warn the agriculturist of their probable appearance. Here, however, the same trouble awaits us. A single mistaken prediction discourages the few who will follow our direction, and we get only derision from the remainder. In my own correspondence I have advocated the same measures against these as in case of the Wire Worms, viz., a rapid rotation of crops, especially of grass or clover, and fall plowing, whenever it can be done without detriment to the fields. What has, or is likely to be accomplished by the use of fungoid parasites, I do not know. The opinion of our presiding officer, who is experimenting in that direction, will be of interest to us all. As in the case of the Corn Root louse, *Aphis maidis*, Fitch, or *Aphis maidi-radicis* Forbes, less injury is done in fields that have been fertilized with barnyard manure.

The Corn Root-worm, *Diabrotica longicornis*, Say, has by its ravages cost the farmers of the Mississippi Valley millions of dollars during the last fifteen years, every penny of which might have been saved by a judicious system of husbandry. Every member of this association, located in the infested area, has again and again sounded the alarm and announced the remedy, yet I fear there are some who have not heard it. In Ohio it is unknown, except along the western border of the State. Its occurrence here, where it was reported last year for the first time, raises the question of its eastward diffusion—a problem which I hope to be able to solve. The congener of this species, the Southern Corn Root-worm, *Diabrotica 12-punctata*, Oliv., will certainly not be managed so easily. There is yet some investigation to be done on this species, before we can confidently advise in regard to its destruction. It appears, in the adult stage, to be well-nigh omnivorous, and the larvæ travel freely.

The Corn or Boll Worm, *Heliothis armiger*, Hbn., is more especially a Southern species, though as far north as Chicago, there are during some seasons two broods, as, in that portion of Illinois, I have found half-grown larvæ in the ears of ripe corn, in November. In the North the damage done is trivial, often being due to the rain and dew running into the affected ears, causing them to decay. Among the market gardeners, where

it works in the sweet corn, the measure suggested by Prof. French, several years ago, which was late plowing in the fall, will do much to hold the species in check. In the South the most sensible and practical suggestion that I have seen mentioned is to plant corn early among the cotton in order to attract the early brood of worms, and then destroy the corn in a way to kill the depredators.

For the major portion of the cutworms; I have much faith in laying down of poisoned grass or clover baits, but the larvæ of *Hadena devastatrix*, Brace, and H. *stipata*, Morris, can not be reached in this manner, as they do not come to the surface to feed. The first eats the plants directly off a short distance above the roots, while the last eats into the stem at about the same place, then tunnels its way upward, eating out the heart after the manner of the Stalk Borer, *Hydræcia nitela*, Gn.

I have here to introduce a third species of Hadena, *H. fractilinea*, Grt., and an entirely new depredator in our cornfields, at least so far as published records are concerned. In fact we rarely find the species mentioned at all in our entomological literature. The imago was described in the *Canadian Entomologist* (vol. VI, p. 15, January, 1874), the habitat there being given as Canada (Petit), Albany, N. Y., (Lintner). Prof. G. H. French, who first determined the species for me, has it from Maine and New York, and Prof. John B. Smith has it from Maine to Ohio, Minnesota to Colorado. How far south it extends I do not know. The adults are so exceedingly quick in movement and secluded in habit that it is not surprising that it should be overlooked. Several specimens of both sexes that were transferred from the cage in which they were reared to another in which grass was growing were not observed afterwards.

The habits of the larvæ are in strange contrast with those of *stipata*, at least in the cornfields, where that species works entirely below ground, entering the stem just above the roots and eating its way upward, while in this species they climb up the plant and eat downward, devouring the whole interior of the stem down to a point where the *stipata* would begin. If the plant be a young one—that is only 2 or 3 inches in height —these larvæ will enter the cylinder formed by the youngest leaf ; but if the plant be older and tougher they will eat downward along the edges until the tissue is more tender, when they will enter the stem and work downward. The time of oviposition I am unable to give. Larvæ, from two-thirds to quite full grown, were taken the last of June, when they were said by farmers to be disappearing. From these larvæ imagoes appeared, *in the insectary*, the last days of July and up to the 10th of August. I did not observe them, nor can I learn of their occurrence elsewhere than on spring-plowed grass land, and this, either wholly or in part, timothy sward. There appeared to be no difference in point of injury between early and late spring plowing. There did not appear to be any disposition on the part of the larvæ to wander about, but if the corn was planted in hills, after finishing one stalk they would abandon it and attack another, and so on until all were destroyed.

The larvæ, from which all of my adults were reared, were taken from corn plants, either in the field or from plants sent me by my correspondents, and I saw every one of them in transferring them to the breeding cages. All were working in corn in precisely the same manner and there was certainly no noticeable difference in the larvæ. The imagoes, however, were those of two species, as they are now understood, the larger number being the one under consideration, while the remainder were *Hadena misera*, Grt. If, therefore, the two species are distinct, then this almost must be added to the list of corn-destroying insects, and a further study will be necessary to separate the larvæ, whose depredations appear not to differ. Prof. Smith writes me that he has this last species from Colorado, taken by Bruce, and also from Minnesota, bred by Prof. Lugger. All this, of course, does not disprove the validity of the species, as, if I remember rightly, there is a strong resemblance between the larvæ of *H. fractilinea* and *H. stipata*, as I observed them in corn in Indiana some years ago.

The various species of web worms, larvæ of several species of Crambus, are, of late, working nearly as much damage in our cornfields as are the cutworms, and are even less accessible. The larvæ of at least three species have this season devastated the cornfields of eastern Ohio, one of which appears to feed below ground exclusively. For my part, I

am puzzled to know how to deal with these. Can it be done by breaking the sod in early summer, and allowing the wind and sun to dry out and kill the grass roots, thus starving the very young worms? The plan of breaking the ground very late in spring and planting the crop immediately I find often fails of protection.

In conclusion, permit me to direct attention to the fact that the field of the economic entomologist is but poorly defined. To work out the life-history of a species and study its relations to other forms of life, learn what substances will destroy it, determine what course of procedure is calculated to prevent its breeding, would appear to constitute our true field of labor, but we are expected, by some sort of magical power, to transform ourselves into carpenters, mechanics, or civil engineers, and devise machines, methods, and all the details of application in a manner to fit the current notions of agriculturists.

Now, it seems to me that this is not necessarily all applied entomology. It belongs, it appears to me, equally as much to the science of applied agriculture, and I am in favor of giving the farmer the opportunity of putting his own shoulder to the wheel and exercising some of his own ingenuity to help himself. Outbreaks of the injurious insects, like the diseases of the human system, are due to certain foregoing causes over which the entomologist has no control whatever, but when the trouble comes we are expected to go out and instantly stop it. You all know how impossible this is, and yet how difficult it is to make people understand the impossibility of it. I think that at present we are doing our whole duty and even more.

I congratulate the members of this association on the progress we are making. No nation on earth is making or ever has made such rapid advances. We make some mistakes it is true; who that does anything at all does not? Honest errors are not only no disgrace but may be of value to those who follow after. We are profiting by the mistakes of Harris, Fitch and Walsh; why may not those who shall carry the work forward after we are gone likewise profit by ours?

In discussion, Mr. Howard stated that *Isosoma tritici* occurs outside the limits Mr. Webster assigned it, since it has been found east of the Alleghanies.

Mr. Forbes remarked that it cannot be inferred that the Hessian Fly is single brooded in a region where no winter grain is raised, on the evidence of the absence of winter grain alone, since volunteer spring grain may give opportunity for the breeding of a second generation, and in this connection instanced an observation of his own in the spring wheat region of northern Illinois, where the fly is admittedly double brooded, but where he found it infesting barley in spring.

In reply to questions Mr. Webster stated that a difference in the relative injury by Hessian Fly observed by him in two fields was due to the better condition in which the ground was kept in the case of one of them, so that wheat sown late enough to escape the fall attack grew rapidly and went into the winter in prime condition, while in the other field the wheat, if early sown, was infested, and, if sown late, was winter killed.

Mr. Webster stated in this connection that the fall brood of the fly scatters everywhere for oviposition, while the spring brood does not range widely, but is most likely to lay again on other plants (suckers, etc.) in the same field.

Mr. Riley asked Mr. Webster to give some account of the actual experiments and observations which had led him to make the statement in reference to the Apple Aphis (*Aphis mali*). He had for a number of years known that this species had a summer existence on various grasses, and had been very anxious to have Mr. Webster, while an agent of the Division of Entomology, follow the full annual cycle of development so far as the wheat plant was concerned.

Mr. Webster said that he felt that his experiments were sufficiently conclusive.

The fourth session was held on the morning of August 16. The Committee on the President's Address reported in favor of the adoption of his recommendations, and the appointment of a standing committee to present a detailed plan for co-operative work among members and to make recommendations concerning legislation. The report was adopted and Messrs. Osborn, Smith and Garman were appointed a committee.

FUMIGATION WITH BISULPHIDE OF CARBON FOR THE COMPLETE AND RAPID DESTRUCTION OF THE INSECTS WHICH ATTACK HERBARIUM SPECIMENS, FURS, WOOLLENS, ETC.

By H. du Buysson, Brout Vernet, France.

The fumigating chest for use with bisulphide of carbon has been employed for many years in the preservation of unpoisoned herbaria, which would infallibly be devoured without this annual or biennial precaution. These fumigations may render great service in the preservation of other objects more useful than the specimens of a herbarium. I shall describe, therefore, the first method used, and every one will know how to apply it to his own needs.

Description of Fumigating Chest.

It is in principle a rectangular box of light wood, lined with thin zinc, which is carefully soldered at all joints. Around the edge of the box, inside, runs a little gutter of zinc, carefully soldered. This gutter is filled with water and serves to make a water seal by means of the flange of the lid, which is also covered with zinc and carries all around a strip of the metal bent at right angles, and long enough to plunge into the water in the gutter. In this way the box is hermetically sealed and the vapors of the bisulphide cannot possibly escape from it.

Use in the Preservation of Herbaria.

Botanists now generally poison their specimens, and the fumigating box is seldom used. Nevertheless it has served me well and I still resort to it from time to time, to preserve such plants as I have not time to submit to the action of arsenic in alcohol or to bichloride of mercury.

The process in question is based upon the great volatility of bisulphide of carbon at ordinary pressure and moderate temperature. The penetration of its vapor is so considerable that we have only to pile up in the chest the mounting sheets of the herbarium, one above the other, in order to fumigate them. They are penetrated to the very centre, and eggs, larvæ, and pertect insects, Anobium or Attagenus, are killed. Space should be left and right of the pile for the vessels containing the bisulphide. Those which I use are of zinc and measure 10cm. long, 6cm. wide, and 9cm. deep. There is no risk in prolonging the fumigation; on the contrary there is but the greater certainty of its being efficacious. Five or six days will be time enough. No limit need be set to the quantity of bisulphide used; what is not evaporated will serve for a new charge.

The disagreeable odour of bisulphide of carbon is not persistent; it is not even necessary to spread open the mounting sheets; it is only necessary to expose them, unopened, to the air. I would call attention, however, to one very necessary precaution, if accidents are to be avoided. The vapor of bisulphide is very inflammable, and the chest must, therefore, be set in a safe place and not opened near a fire or any flame whatever. It would be risky, for example, to unpack the chest in the evening while holding a lamp in the hand.

As the odor of bisulphide is very disagreeable and may cause discomfort to some persons, all these operations should be performed in an attic or in an apartment of which the windows may be left open as long as necessary.

Preservation of Furs and Woollens.

The same process may be used in the preservation of clothing in clothing establishments, civil or military, where Tinea and Attagenus sometimes cause such ravages. Special arrangements may be adopted in establishing fumigating chests or rooms to avoid the settling due to weight and to facilitate the penetration of the gas.

This method makes it certain that we shall not "shut the wolf up in the sheepfold." Articles fumigated are entirely rid of eggs, larvæ, and living insects. They may be shaken out in the open air for greater security and then replaced on the shelves, with the assurance that they will not be found gnawed when next visited.

Preservation of the Stuffing of Furniture and Saddles.

Tinea and Attagenus have a marked predilection for horsehair, so that these insects are sometimes found flourishing in the stuffing of our furniture, even that which is in daily use. This process has the advantage of permitting us to destroy them without having recourse to the upholsterer; we need but to construct a fumigating chest large enough to contain a couple of armchairs or more. In the same way we may treat mattresses, eider-down quilts, or anything which is supposed to contain eggs or larvæ.

I have experimented with a saddle much damaged by months, and after fumigating it five days noticed no appearance of insects; the saddle was completely penetrated by the vapor and all the moths perished. I kept it two years under observation in order to be assured of the efficacy of the process.

Disinfection in Epidemics.

I am persuaded that clothing subjected to this process would be disinfected quite as well as by the processes usually employed in certain epidemics, such as typhus, cholera, smallpox, etc. It seems to me that the vapors which penetrate fabrics so well and kill insects so thoroughly would act in the same way upon the microbes which engender epidemics.*

In discussing this paper Mr. Atkinson stated that he had used a very similar box in fumigating objects infested with insects.

Mr. Garman called attention to the fact that at the museum of comparative zoology at Cambridge, a large upright zinc-lined case was constantly used for disinfecting the skins of birds and mammals.

Mr. Riley had used bisulphide of carbon successfully for his insect collections.

Mr. Smith had used it successfully for ants, and found it not injurious to vegetation.

Mr. Garman reported having found it effective in destroying the Melon Louse. His method of applying it was to roll the vines up in a heap, then invert a tub over them, and after placing a saucer containing a tablespoonful of the bisulphide under the tub, its edges were pressed down into the soil or the earth was drawn up when necessary. He had tried the fumes of burning sulphur and tobacco, but the former injured the plants and the latter did not kill the plant lice, many of them gradually recovering after being stupefied by it.

Mr. Smith thought since the aphides often spread from particular plants or hills, the use of bisulphide in good season might make it possible to prevent the injuries of these insects.

Mr. Atkinson read a paper by Dr. J. Ritsema, Bos., on "Aphelenchus olesistus, nov. sp., a nematoid Worm, causing Leaf-sickness on Begonia and Asplenium." He referred to a note by Mr. Atkinson read at the preceding meeting of the Association, in which an Anguillulid is described as affecting leaves of Chrysanthemum and Coleus, making no swelling or deformity, but causing brown patches on the leaves. The author having studied and described *Aphelenchus olesistus* in Europe, where it causes almost precisely the same trouble with Begonia and Asplenium, is inclined to think that the species previously mentioned by Mr. Atkinson is identical. In the discussion Mr. Atkinson stated that while there were characters in the form studied by him which seemed to place it in the genus Tylenchus, he thought that careful comparison of types might show the two to be identical.

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*Note.—I have observed in bisulphide of carbon no clearly defined power of taking out the colors of fabrics which I have subjected to its vapor. It may, therefore, be used without fear, except, perhaps, in the case of the most delicate tints.

METHODS OF ATTACKING PARASITES OF DOMESTIC ANIMALS.

By Herbert Osborn, Ames, Iowa.

In dealing with insect parasites of domestic animals we need to consider, first, the method of attack of these parasites, and we may conveniently separate them into the external parasites and the internal parasites. Among the former we have various species of lice, itch-mites, ticks, and can also include those forms which affect the external parts of the body by depositing eggs in sores. In the latter series we may include the different kinds of bot flies affecting the internal organs and certain forms of degraded Acarina which also affect certain internal organs. It is unnecessary here to detail the mode of attack of the external forms more than to mention that some pierce the skin to suck the blood, others simply feed upon external excretions, producing pustules, scabs, etc.

First among the methods of treatment we should consider that of prevention, since, for perhaps the majority of the parasitic forms, a little effort in the direction of prevention is far more effective than costly and laborious methods later on

With a large majority of parasitic species, including all of the lice, the sheep-infesting Hippoboscidæ and all of the Sarcoptidæ, infection results from the mingling of parasitized animals with those which are free from parasites. It is therefore possible by attention to animals introduced into a herd, or sometimes into a new section of country, to prevent entirely the introduction of the parasites. To accomplish this it is necessary to examine introduced animals, and if infested, or suspected of being infested, use thorough treatment upon these. In the case of introduced cattle infested with Hypoderma it would seem possible that they might, by being carefully watched and the grubs destroyed, be prevented from introducing this pest in any new locality. Since the parasite occurs only in the bodies of cattle during the winter season, I see no reason why attention to imported cattle should not serve to totally exclude this pest from any locality which has hitherto been free from it. The bots in horses may be prevented by the well-known method of shaving off the eggs, so as to prevent the introduction of the larvæ into the mouths, while for the bot fly affecting the sheep I am not aware of any more effective plan of prevention than that of applying tar to the noses of the sheep. For direct treatment, the methods for external parasites may be grouped under the head of washes, powders, and fumigation. The use of washes, in the treatment of parasites is perhaps one of the oldest methods. The modifications consist in the methods of applying or in the materials used as a wash. The method of application will depend somewhat upon circumstances, but should aim to reach all parts of the body, and particularly those parts most infested. Sponging the animal with a cloth or sponge dipped in the insecticide material and application by means of force pump in certain cases, particularly for hogs and thin-haired animals, is practicable in certain forms. A device recently presented by Dr. Francis, of Texas, provides for the pressure by means of gravity, the barrel being elevated on a derrick and connected by hose with several nozzles directed downward, and a movable one to use in spraying the under parts of the body, the liquid being collected by a drip platform in a receptacle below. The liquid, however, is elevated by a pump, and while it may lessen the number of men necessary in spraying, the same end can easily be accomplished where a force pump is at hand, if it is connected with several nozzles adjusted so as to play at proper angles on the animal. Dipping is probably the most speedy and effective method to use on a large scale, and especially for thick-haired or woolly animals, and for this purpose receptacles ranging all the way from a small tank for the treatment of a single animal at a time up to a large tank, including two or three dozen sheep at once, may be used. The ingredients for these washes have consisted mainly of tobacco, sulphur, lime, tar, kerosene, and arsenic, and each of these materials will be found to have its advocates.

Special formulæ for their combinations have been published in abundance, and need not be repeated here. Aside from these published formulæ there are different preparations on the market, some of which are doubtless valuable, and if the item of expense is considered satisfactory, it is perhaps proper to recommend their use. Kerosene emulsion

has been used with success by Prof. Gillette on cattle and hogs and by Dr. Orcutt and Mr. Alkrich for sheep dip, but Prof. Francis pronounces it less satisfactory than some of the proprietary combinations for ticks on cattle. I have also seen some reports of poor success with it or apparent injury, especially to lambs, from its use.

While I fully believe in its efficiency when properly made and applied and would attribute failures to improper preparation, the fact that such failures occur in practice is somewhat unfavorable to the general adoption of this remedy.

The various powders used are tobacco, sulphur, pyrethrum, snuff, and common road dust (the latter presumedly acting by closure of the spiracles) and of the other substances, tobacco or preparations including this material may probably be considered as most generally useful.

Pyrethrum if dusted in among the hairs so as to thoroughly reach the insects when first applied, is quite effective and may be used for fleas and lice, but probably would not affects the mites.

Fumigation is a method which presents some advantages where it is practicable, because it can be used during winter when washes are objectionable and is preferable to powders, because all of the individuals affecting an animal may be killed and thus entirely free it, whereas by the other method the survival of a few individuals may restock the animal. A simple plan of adopting this is to cover the animal with a blanket, leaving the eyes and nose exposed, but having the blanket reach the floor or ground and made as tight as possible at all points to prevent the escape of fumes. Puff tobacco smoke under this blanket by means of a bee-smoker. This plan first came to my notice as recommended by Mr. Charles Aldrich, who claims for it very effective work. I have also seen a description of a plan for fumigation of fowls which involves the same principles. Some years ago I suggested the plan of using a tight stall, with an opening at the head, a canvas protection, so as to leave the head, eyes, and nose exposed and free; and some experiments with this method showed that fumes of either sulphur or tobacco are very effective in destroying lice, both the Pediculidæ and Mallophagidæ. The time of exposure to the fumes varied from twenty to twenty-five minutes in these experiments. The sulphur or tobacco were burned over an alcohol flame, but I should presume a preferable plan would be to place the substance in a tin or sheet-iron tube, closed at one end, with the open end projecting into the stall, and drive the fumes off by means of heat applied to the under surface. The common little lamp-stove could be used. The stall should be made as small as possible to accommodate the animal, in order that the fumes may be as dense as possible, and on this account the simple covering with a blanket is perhaps preferable, as it adjusts itself to the animal, but provision should be made for the free circulation of fumes on the parts of the animal where the blanket would press.

Feeding of sulphur with salt is strongly recommended by some, and Mr. Weed, of Mississippi Station, gives it a strong endorsement as a result of experiments at that station directed especially against the cattle tick (*Ixodes bovis*, Riley).

Mr. Gillette asked how the hen louse could be destroyed.

Mr. Osborn, in reply, said he thought the use of tar on the ends of the poles in the henhouse could be made to answer the purpose.

Mr. Aldrich thought it not safe to recommend kerosene for destroying insects on animals, because of the injurious effect on the skins of the host.

Mr. Gillette replied that he agreed that kerosene should not be used for sheep, but for hogs and cattle it was useful.

Mr. Riley remarked that he was deeply interested in a change of opinion resulting from later experience and experiments regarding the usefulness of the kerosene emulsion in destroying animal parasites, and particularly in Mr. Gillette's altered experience in reference to its use on sheep. He thought, however, that the difficulties of making a good kerosene emulsion and of getting intelligent farmers to use it safely were unnecessarily magnified. He could not accept the doctrine that of two given remedies the poorer one was to be recommended because the better required a little more care and intelligence in making and using.

Mr. Hopkins had used sulphur for stock at all times and found it not injurious.

Mr. Weed reported that sulphur and salt mixed were fed to stock in Mississippi for ticks. Some thought it ineffective. But it was tried at the station and found to be a complete remedy. It had been claimed that sulphur used during wet weather was injurious, but this was tried and found not to be true. Sulphur has been supposed to cause a decrease in the quantity of milk, but careful experiments at the Mississippi Station had shown this to be untrue. The sulphur and salt should be kept in use constantly. Ticks, he thought, infested by preference, animals in poor health, and the chief good done by feeding sulphur and salt was keeping up the health of stock by destroying internal parasites.

Mr. Gillette inquired if the real bedbug ever occured in hen houses. A case occurred in Iowa where bugs, which appeared to be the same as that found in dwellings, were abundant.

Mr. Howard remarked that Townsend, of New Mexico, had recently discovered another species (*Cimex inodora*, Dugès) in henhouses.

Mr. Osborn thought the character of the form occuring in henhouses might be considered either varietal or specific.

In the paper by Mr. Weed on "Remedies for Insects Injurious to Cotton," the author discussed the application of Paris green against the Cotton Worm by means of bags at the extremities of a long pole carried by a "darkey" on a mule going at a brisk trot between the rows. This he considered to be the most simple apparatus which he had seen for distributing dry poisons. For the Boll Worm he considered the best application to be the planting of a row of corn about every tenth row through the cotton field at such a time that it will mature early in September.

THE CHEESE OR MEAT SKIPPER.

(*Piophila casei.*)

By Mary E. Murtfeldt, Kirkwood, Mo.

In dealing with the insects detrimental to agriculture the entomologist encounters no obstruction in the reluctance of the farmer to have his losses made known. With the pessimism characteristic of the profession, the latter is inclined to exaggerate rather than to make light of his difficulties and losses, and therefore gives the fullest publicity to any agency from which he suffers; but in the investigation of the habits and economic relations of an insect injurious to manufactured products the case is very different. The prudent manufacturer or merchant is very careful not to give to the public any fact which might arouse suspicion concerning the quality or durability of his products or wares. In the case of manufacturers such caution is especially necessary, as the tide of trade is so easily turned, and there are so many rivals in the field eager to take advantage of the smallest fact to the prejudice of a competitor. As an instance of this, one of our shoe manufacturers in St. Louis found, some years ago, that his stock was being injured by the Leather Beetle (*Dermestes vulpinus*, Fabr). In his desire for a remedy he very appropriately applied to Dr. Riley, of Washington, who instituted an investigation as to the nature of the depredator and the means for eliminating it. I had the honor to assist in these studies, and I well remember the change of manner in the proprietor of the concern between the first visits to his establishment and those made later. At first every facility for observation was granted, and all questions fully and obligingly answered; but subsequent visits were somewhat coldly received and very little information could be elicited, and there was a general air of desiring to ignore the whole matter. This was explained some time afterward, when a partner in a rival firm chanced to mention that his business had profited considerably by the publication that So-and-So's shoes were "wormy;" and the latter declared that the attention which the "bug-hunters" had drawn to the matter "had damaged his trade to the extent of several thousand dollars." Such experiences inculcate caution in mercantile circles, and through this the entomologist undoubtedly loses many an interesting subject for study. Perhaps this might be amended if it was understood that names would not be published without permission.

In the case of the insect upon which I beg here to offer a few notes, no household pest is, perhaps, better known. The manufacturer, the grocer, and the housekeeper, have each a considerable share in the loss which it occasions. For ages it has been the chief enemy of the chesse maker, the best and richest of his products being most liable to its attacks. It does not, however, confine its ravages to cheese, but within comparatively recent years has become known as an equally, or rather far more, formidable destroyer of cured meats, causing the loss of thousands of dollars' worth of property annually, and necessitating the spending of other thousands in labor and mechanical contrivances to keep it in check.

Although of European origin, it has spread to all parts of North America, where it probably does tenfold the damage that it does in its native country. In view of these facts, and considering the hundreds of articles that have been published upon insects of no greater economic importance, it is really surprising that the American records of this pest should be so few and so brief. Before entering upon an investigation of its habits I made a search for the literature of the subject, only to find that it had received but slight attention from our entomologists, from either a scientific or an economic standpoint The only notes relating to it that are to be found in the annals of American Economic Entomology are the following:

In the *American Entomologist* (vol. II.), published in 1870, is a copy of an article by X. A. Willard, giving a somewhat elaborate account of the destructiveness of the insect as a "cheese fly," with various recommendations of measures to be taken in factories and storerooms to preserve the products from its attacks. Appended to this is an editorial note giving an outline of its life history, with the statement, that so far as was then known, it was exclusively a cheese pest. In volume III. of the same periodical, published in 1880, Dr. Riley briefly discusses it as an enemy of cured meats, here asserting its identity with the cheese fly. Dr. Packard, in his Guide, gives in a few lines its principal characteristics, and refers to an observation of Prof. Putnam concerning the method by which it "skips." In volume IV. of *Pysche* I remember to have seen something on the subject, but can not at present lay my hands upon the number containing it. In the report of the Entomological Society of Ontario for 1884 is also a brief paragraph of description of it as a cheese pest. Not doubting that there were other works not in my library in which it was more fully discussed, I applied to Dr. Williston, as our leading dipterologist, who very kindly answered:

> I, also, have had occasion to search for the life history of *Piophila casei* without success. I supposed there would be no difficulty in finding a full description of its habits, but was surprised to find no, or very meagre, references in any literature at my command. . . . If you have studied its habits you will do a service by publishing them, even though it may happen that they have already been published, which I doubt.

Dr. Riley, however, informs me that the literature of the insect is sufficiently extensive, though scattered, and that several European writers, and especially H. F. Kessler, have within recent years given careful accounts of its development and life history.

As it was my desire to bring the matter to the attention of the economic entomologists at the present meeting, I did not have time to obtain transcriptions from the authorities to which Dr. Riley refers, and so will offer here a popular synopsis of my personal observations, in which I am conscious there are some gaps and uncertainties. Those desiring a more minute and technical account can consult the works named by Dr. Riley.

My attention was directed to this pest about a year ago by an employee of one of the largest packing and curing establishments in the West, who wrote: "We wish to know what it is, and especially at what period in its life it can best be fought. It entails an enormous loss upon all our packing-house companies." Upon my request specimens of the infested meat were kindly sent me, and Mr. D——, my correspondent, gave me much valuable information concerning its work in the packing-house.

The packages of ham and shoulder were received during the month of August, 1892, and consequently represented the worst work of the insect for the season. Swarms of flies escaped from the boxes as they were opened, and myriads of "skippers" and puparia in all stages of development were disclosed, clustering around the bony ends, among the tendons, and in the softer fat and oil saturated folds of the canvas wrappers. The lean meat was never in any case penetrated, although eggs and small skippers were abun-

on the surface ; nor was the solid fat much damaged. The methods of curing these meats had been so perfect, that even after an exposure of two or three weeks in an open shed to the August heats, upon cutting into the centre of a ham and the thickest part of shoulder they were found to be perfectly sound and sweet. In justice to the "skippers," too, I must say that their work does not induce putresence or ill odors, and although the spectacle of a ham swarming, externally, with the various forms of the insect is the reverse of appetizing, yet a large part of it is still edible, and, the outside removed, would be available for potted meats and similar preparations. But, of course, in the original shape it is absolutely unsaleable ; hence the loss.

The life history of the insect, so far as I have been able to trace it, is as follows, popularly presented : It hibernates in the perfect state, hiding, like the house fly, in cracks and crevices of the buildings which it frequents, and behind furniture and machinery. The flies become active only when warm weather sets in. According to my informant they are first noticed, in the curing establishments, around the vats of "yellow wash," which is composed of glue, rye flour, and coloring matter, possibly attracted by the odor of the glue. If not rigidly excluded they follow the pieces of canvassed and yellow-washed meat to the storerooms and deposit their eggs upon the wrappers, preferably among the folds, if they can find an opening that will admit them, otherwise upon spots where the fat has penetrated and loosened the wash. It has been difficult to ascertain the exact number of eggs laid by a single fly, as they are deposited not only in more or less compact clusters of from five to fifteen, but are also scattered singly. In the observation jars the average was about thirty, but it is possible that in these jars, confined upon small bits of meat and subject to much disturbance, the conditions were not normal, and the number of eggs may, in consequence, have been reduced. Those of an individnal seemed to be all deposited about the same time, in the course of an hour or less, soon after which the insect perishes. The egg is pearly-white, slender oblong, slightly curved, 1^{mm} in length, with a diameter about one-fourth the length. Hatching takes place within thirty-six hours, and, leaving a filmy pellicle behind, the minute, translucent-white larva moves with wonderful activity in the direction of the food supply. Except in increase in size, it does not change much in its characteristics. It is cylindrical, tapering gradually toward the anterior end, and is truncate posteriorly, furnished at this extremity with two horny, projecting stigmata and a pair of fleshy filaments.

There is no variation in the white color except in the retracted mouth-hooks, which show a shade of dark gray. Dr. Packard, in his Guide, quotes from an observation of Prof. Putnam regarding the leaping power of the insect :

> When about to leap, the larva brings the under side of the abdomen toward the head while lying on its side, and reaching forward with its head and at the same time extending its mouth hooks, grapples by means of them with the hinder edge of the truncature, and pulling hard, suddenly withdraws them, jerking itself to a distance of four or five inches.

To my knowledge the distance to which it "skips" is often much greater. I think the "skipping" a latent power in the insect as a meat pest, as there is no occasion to exercise it by the majority of the individuals. When breeding in cheese it would be necessary in many cases to escape by this means to some place in which it could transform in safety, but on the canvased packages of ham and bacon the folds of the wrapper afford the most desirable of hiding places. It completes its growth in seven to eight days, attaining a length of from 7 to 9^{mm}, with a diameter at the posterior end of 1.5^{mm}. While feeding, if the food supply is sufficient, it does not move about much, entire clusters of larvæ often completing their growth in the same bony crevice in which the mother fly had deposited the eggs. When mature, however, it crawls, pulling itself along, apparently by the mouth hooks, into some fold of the wrapper that is comparatively dry, and from which the fly will easily be able to escape. Here it begins to contract in length and assume a yellowish hue, and the separation of the outer skin from the body can be clearly seen. The former gradually hardens and darkens into a golden brown, oblong segmented shell, 4 to 5^{mm} in length, and which still retains the larval projections on the posterior end. Within this puparium the larva rests for a time—I have reasons for believing for thirty-six or forty-eight hours, perhaps longer—unchanged, except for a slight reduction in size. I had occasion to observe the action of one of these larvæ whose case was accidentally broken. It wriggled and twisted about in the most unsatisfied manner, but seemed to

have lost its skipping power, and was constantly thrusting its head or its posterior extremity into the deserted puparia that were scattered at the bottom of the jar. Whether it was able to complete its transformations I can not now say.)

Both transformations, although involving such radical, formal and functional changes, take place within a period of ten days, as nearly as I have been able to ascertain.

The perfect insect is a shining black fly with bronzy tints on the thorax and slight iridescence of the wings. The latter overlap nearly to the tips when the insect is at rest. The legs are dull black, shaded at the joints to dull yellow or fuscous. In size it is about one-half that of the common house fly. There is no good figure of this insect in any American publication, that in Packard's Guide being in outline merely and not available for recognition except by the skilled entomologist. The fly is not active at night, but is able to perform its life work in the obscurity of partially darkened closets and storerooms. To make these absolutely dark would, in my judgment, effectually exclude it.

I have not been able to make it oviposit on fresh meat of any kind, nor does it seem able to breed upon that which is simply salted, but not smoked, not even when such meat is folded in wrapping papers. It will sip a little at sweets, but is not greatly attracted to them, while the odor of smoked meat speedily summons it. The average duration of life, in the perfect state, in summer, does not exceed a week, according to observations made upon it in the rearing jar, which may not, however, exactly indicate it. The entire life cycle would seem to be included within three weeks, but there is no definite succession of broods, and the insect may be found in all stages from May until October or November. When exposed to severe and protracted cold, larvæ, pupæ and flies are killed. The flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon them, produces the same stupefying effect that it does upon other Diptera. The firm in whose behalf these investigations were undertaken informs me that in order to exclude the fly they screened all windows and doors with a 24 to the inch wire mesh. They also, early in the spring, thoroughly whitewashed and fumigated smoke-houses and storerooms, using an admixture of carbolic acid in the whitewash, thus effectually sealing up or killing all hibernating individuals that might be lurking in these places. I have not been able to recommend any repellant chemical that could be safely incorporated with the wash used on the outside of the wrappers. Mr. D—— also informs me that sulphur fumes in the storerooms give a streaked and unattractive look to the wash, and the use of this repellant is therefore impracticable.

Smoked beef also suffers to some extent from the attacks of this insect, but, as Mr. D—— says, "not nearly so badly as pork. If a beef ham were hanging beside that of a hog, the former would most likely be O. K., while the latter would be stung."

In my correspondence with cheese manufacturers I learn that the loss of their products is now far less than it formerly was.

One of our leading cream-cheese makers writes:

> We are always somewhat troubled with the cheese flies in summer. To keep them out of our storerooms we cover the windows with light domestic, as they will go through the ordinary wire screen, but as there will always be more or less of them in the rooms, we have the brown fly paper in water always on hand, which keeps them pretty well in check. They are worst during the hot season. We do not use any chemicals, as they would be likely to injure the quality of the cheese. The flies deposit their eggs on the outside of the cheese, and in thirty to thirty-six hours they begin to squirm and work their way inside, so we usually go through the rooms twice a day and look for eggs. They are easily found on the smooth surface, but if the bandage is wrinkled or cracked we sometimes miss them. We have not had over $5 worth destroyed in two years, and are turning out 800 cheeses per day.

Another large manufacturer informs me that he

> depends mainly upon fine screens to keep out the fly, and also darkens his storerooms; has each cheese rubbed hard each morning; uses no chemicals, but a cheese grease that contains some rosin, which gives a hard coating. Loss not more than 1 per cent., some seasons not over one-fourth of 1 per cent.

These reports are encouraging as showing with what comparative ease the insect may be kept in check when once its habits are thoroughly understood. It is hoped that these few notes, not in all particulars conclusive, may prove of some assistance in popularizing that knowledge.

Mr. Aldrich spoke of an English custom of placing cheese under the tap of a beer keg, so that the drip would encourage the development of the insect. He had been informed that the maggots improved the quality of the cheese.

Mr. Riley said it was true that this was not only an English, but a European practice.

Mr. Coquillett's paper, entitled, "Hydrocyanic Acid Gas as an Insecticide," was read by the Secretary. The paper consisted of an historical review of the use of this gas in California, together with an account of the methods in use at the present time and some slight consideration of its effect upon different insects. The cost of fumigating a tree varies from 5c. to $1, and even at the latter rate figures were produced to show that it is economical.

ON ARSENICAL SPRAYING OF FRUIT TREES WHILE IN BLOSSOM.

By J. A. Lintner, Albany, N. Y.

The long-mooted question: Are honey bees poisoned by arsenical spraying? is still an unsettled one. There are those who claim that a great mortality among bees is the result of their visiting blossoms that have been sprayed with Paris green, while others hold that the mortality so frequently observed at this time is ascribable to other causes, and that the arsenic would not reach the nectar of blossoms, and, being an insoluble substance, could not affect the bees or be communicated to the honey. This latter view has been entertained by some of our best botanists. The pollen, however, might contain arsenic and thus become poisonous, not only to the bees visiting the blossoms, but also to the nearly-matured, chyme-fed larvæ, to whom it might be conveyed.

In behalf of a committee appointed by the Association of Economic Entomologists to investigate the matter, Prof. F. M. Webster, of the Agricultural Experiment Station of Ohio, chairman of the committee, has recently reported progress in the investigations undertaken, to the following effect: He had experimented with a hive of bees placed underneath a sprayed plum tree wholly inclosed with a fine netting. Within two days thereafter a large number of dead bees were taken up from the cloth with which the ground had been covered. Without much doubt, most of these had been killed in their efforts to escape from their confinement. Examination of the bodies of the dead insects before washing and after they had been washed, to remove any arsenic that had been attached to their surface from contact with the sprayed blossoms, gave to the examining chemist the presence of arsenic. In another experiment made, hives of bees were placed under sprayed trees, but without any enclosing net These also gave dead bees with arsenic upon them, but in much smaller numbers.* The experiments were not deemed conclusive by Prof. Webster, and it is intended to continue them another year.

That the bodies of crushed bees that had visited blossoms sprayed with arsenic should disclose to chemical tests the presence of arsenic is not at all strange. Even an ammoniacal bath could not have removed every trace of arsenic from the surface of their bodies.

Prof. A. J. Cook, the distinguished apiarist of the Michigan State Agricultural College, makes the positive assertion that honey bees are killed in large numbers through the arsenical spraying of fruit trees in blossom, but he has not proven the assertion. Experiments instituted by him, in which bees fed on sweetened water poisoned by arsenic—1 pound to 200 gallons—were killed, are claimed by him as decisive upon the question under consideration. How entirely unwarranted the conclusion! The experiment had no bearing upon the question at issue. No one could have doubted that imbibing strongly poisoned syrup would be fatal to honey bees. Furthermore, in his experiment (see Report of the Michigan Board of Agriculture for 1891) the bees were fed in his laboratory, within a small cage. Bees are known to die very soon in confinement, even without an arsenical diet.

A simple method can be resorted to, by which the question could be definitely and effectually settled. It is this: Confine a hive of healthy bees to blossoms sprayed with Paris green, and when death speedily follows, have examination of their stomachs made

* It is possible that these bees may have been caught and killed by some of the predaceous insects, which are known to lie in wait among or near blossoms, whence they suddenly seize the bees and suck out their *juices*, such as the bee-slayer, *Phymata erosa*, and several of the "robber flies" or Asilidæ, of which Prof. A. J. Cook records six species having this habit.

by experts testing for arsenic. If it is found therein, then it may be accepted as the cause of their death. Examination of stomachs of bees collected promiscuously would not be satisfactory, for the statement was made at a recent bee-keepers' convention in Albany that honey bees had been seen eagerly feeding on the liquid resting on the leaves of a potato patch soon after it has been arsenically sprayed, and it was thought to have caused the death of many of the bees.

Up to the present, so far as I know, no examination such as above suggested has been made. I hope that Prof. Webster will undertake it in the progress of his experiments during the coming season.

Prof. Cook desires that "everyone of the United States should pass a law making it a misdemeanor to spray fruit trees while in blossom." I do not know that this, although urged in some of the States, has been done in any. Such a law was passed by the Ontario Legislature in April, 1890. It provides:

> SEC. 1. No person in spraying or sprinkling fruit trees during the period within which such trees are in full bloom shall use, or cause to be used, any mixture containing Paris green or any other poisonous substance injurious to bees.
>
> SEC. 2. Imposes a penalty, on conviction, of not less than $1 or more than $5, with or without costs of prosecution.

That the above law is calculated to protect the interests of both the fruit-grower and honey-producer is the opinion of Prof. J. H. Panton, of the Ontario Agricultural College, as given in Bulletin LXXXI, of the College, issued in November, 1892. He remarks:

> Although there has been no analysis of the bodies of the dead bees for the purpose of ascertaining the presence of arsenic, still the death of the bees is so intimately associated with spraying that there seems but little reason to believe otherwise than that the bees have been poisoned by Paris green used in spraying. However, this will likely soon be settled by analysis of the bodies of bees suspected to have been poisoned, and I have no doubt arsenic will be detected.

There is another important question connected with the arsenical spraying of blossoms, viz., this: May not the arsenic blight the blossom and prevent fruit development? "The portion of pistil," says Prof. Panton, "upon which the pollen falls is exceedingly tender and sensitive, so much so that the application of such substances as Paris green injures it to so great an extent that the process of fertilization is affected and the development of fruit checked." No experiments known to me have been made upon the effect of arsenical spraying on fruit blossoms. That its effect would be to destroy the blossoms is quite probable. Thus, Mr. James Fletcher has suggested the spraying of the blossoms of pear trees infested with the Pear Midge (*Diplosis pyrivora*, Riley) as a remedy for annual attacks of the insect by depriving it of the food (within the young fruit) needed for its development.

There are, then, before the economic entomologist and the fruit-grower, at the present time, these two questions relating to spraying with the arsenites during the blossoming of fruit trees: First, will the poison kill the bees, destroy the young brood and affect the honey? Second, will it blight the blossoms? It would not be a difficult task for an experimental station, and it is specially within the province of the stations, to set these questions at rest and no longer leave them subject to crude observations or individual opinions. Until this shall be done, there should be an entire cessation from arsenical spraying of fruit trees while in blossom, without the enactment of laws which now seem premature and may prove to be not needed; and even if seeming to be needed, are still fraught with evil, from the general disregard with which such laws are treated.

It is unnecessary to say that there should be no restriction of the kind, either optional or compulsory, unless it is shown to be absolutely required. The arsenical spraying of fruit trees has already come to be regarded as almost indispensible to the successful fruit-grower, and day by day its importance is being more fully and widely realized. No longer limited to the control of Codling Moth injury, it is being rapidly extended to other insect attacks. For each week of early spring, I have no doubt but that a calendar could be made wherein each day would stand for the incipiency of the attack by some insect pest or fungous disease, to be combatted in no better way than by arsenical or copper solutions used in spraying. What opportunities may therefore be lost for arresting and defeating attack at the most favorable time, and possibly at its only vulnerable stage, if two or three weeks' armistice is accorded to your enemies, during

which time the army is recruited a hundredfold, the infant becomes a veteran, mines are run, pits are dug, tents are built, covered ways are constructed, insidious mycelium threads are permeating leaf and twig, and in many other of the arts of warfare your wily foes, with their rich inheritance of surprising means for self-protection, have planted themselves in strongholds, where an entire park of spraying pumps, with their baneful poisons, will utterly fail of reaching and destroying them. Far better a cessation of hostilities for any six weeks later in the season than for three in early spring. It has been stated and reiterated many times that the Codling Moth is the only insect against which we need to employ the arsenites in early spring, but this is far from the truth. It is conceded that we can not destroy the Apple Worm until after the fruit is set and the egg deposited thereon, but of the two hundred and eighty known species of insect depredators on the Apple (not referring to those infesting other fruits) it would be strange indeed if there were no others which are specially vulnerable before the setting of the fruit. Let me name a few of those that could be reached at this time :

The well-known Apple-tree Tent caterpillar of *Clisiocampæ americana*, Harris, attacks the bursting buds and the young leaves.

The caterpillars of the White-marked Tussock-moth (*Orgyia leucostigma*, Sm.-Abb.) hatch from the eggs about the middle of May and commence their destructive work.

Among the cut-worms there are a number of climbing species, four of which have been identified, viz , *Agrotis clandestina*, Harris, *A. scandens*, Riley, *A. messoria*, Harris, and *A. saucia*, Hübn., which are known to ascend apple and other fruit trees to feed upon the blossom and leaf-buds and the tender leaves. The odd-looking caterpillar of *Catocala grynea*, Cramer, feeds on the foliage of the apple in May, and those of *Catocala ultronia* Hübner, are often shaken from plum trees when jarring them for the curculio.

The Canker Worm (*Anisopteryx vernata*, Peck) usually appears as the young leaves are pushing from the bud.

The White Eugonia (*Eugonia subsignaria*, Hübn.) one of the family of measuring worms, occasionally appears in injurious numbers about the 1st of May.

The oblique-banded Leaf-roller of *Cacœcia rosaceana*, Harris, spins together the young leaves for its shelter.

The Lesser Apple-leaf Folder (*Teras minuta*, Rob.) attacks the opening foliage and folds the leaf for its retreat.

The Leaf-crumpler (*Phycis indiginella*, Zeller) awakening from its winter's sleep and drawing some of the unfolding leaves together, resumes its feeding.

The destructive Eye-spotted Bud-moth (*Tmetocera ocellana*, Schiff.) so injurious in Western New York, after its larval hibernation in its half-grown state, makes its formidable attack, first on the buds and afterwards on the leaves.

The Apple Bud-worm (*Eccopsis malana*, Fernald) creeps at night from its retreat and, after having consumed the terminal buds, feeds upon the leaves.

The Apple-tree Case-bearer (*Coleophora malivorella*, Riley) emerges from its peculiar pistol-shaped case in which it has passed the winter, to eat the buds as soon as they begin to swell, and afterwards to skeletonize the leaves.

The Plum Curculio (*Conotrachelus nenuphar*, Herbst) enters upon the scene at least two weeks before its first crescent cuts are made in the fruit, ready and free to devote all its energies to obtaining the supply of food needed for the development of its eggs and for the labors attending its complicated and painstaking method of oviposition.

Seventeen species of insects are named above, each one of which is feeding voraciously during the blossoming of our fruit trees. Possibly as many more could be added to the list, all of which could best be destroyed by arsenical spraying.

It is therefore respectfully submitted whether there should be the intermission of spraying as proposed, urged and sought to be made compulsory through legislation, until it shall appear beyond all controversy that the interests of the agriculturist and the fruit-grower—each carefully considered and perhaps weighed one against the other—really demand it.

In the discussion following, Mr. Webster stated that he had as yet reached no positive opinion as to the poisoning of bees by spraying.

Mr. Garman had observed in one instance a bee alight on a recently sprayed tree and suck up from a leaf a drop of the liquid containing London purple. He had no doubt that thirsty bees did sometimes get in this way some of the poison, but whether it was sufficient to injure them or not was a question requiring investigation.

The fifth session was held on the afternoon of the 16th August. The following officers for the ensuing year were elected:

President.....L. O. HOWARD.
First Vice-President.....J. B. SMITH.
Second Vice-President.....F. L. HARVEY.
Secretary.....C. P. GILLETTE.

Three papers on the insects of the season in their respective localities were read by Messrs. Webster, Smith and Osborn, and were discussed by Mr. Riley.

A paper by Mr. R. Allan Wight, of Auckland, New Zealand, was read by Mr. Osborn. It was entitled "*Icerya purchasi* and *Vedalia cardinalis* in New Zealand." The paper consisted of a condensed summary of the history of these two insects in New Zealand and their inter-relations. This paper was discussed by Mr. Riley.

Mr. Smith then read a paper by Mr. F. W. Urich, of Port of Spain, Trinidad, consisting of "Notes on Some Insect Pests of Trinidad, B. W. I." The paper was an interesting summary of Mr. Urich's observations on the injurious insects of that island, and referred mainly to Coccidæ and their natural enemies, a leaf-cutting ant (*Atta sexdens*) a longicorn beetle (*Steirastoma depressum*) and certain Acridiidae. Especial mention of a little Cyprinodont fish was made. This fish is found commonly all through Trinidad and feeds upon mosquito larvæ. Mr. Urich suggests its introduction into America for use in tanks and ponds.

The Secretary then read a "Note on Slip-records," by Mr. Cockerell. The author suggests the use of a uniform system of notes upon slips of a uniform size by all entomologists and submitted samples. The question was discussed by Messrs. Hopkins, Summers and Riley.

The Association then adjourned subject to the call of the Executive Committee.

BOOK NOTICES.

EXPERIMENTAL FARMS: REPORTS FOR 1892. Printed by order of Parliament. Ottawa, 1893.

This valuable Blue-book has been before us for some time, having been distributed in April last, but various circumstances have prevented us from noticing it, and several of the publications for which we are indebted to the courtsey of the authors. Our readers will, of course, be chiefly interested in the report of Mr. James Fletcher, the Entomologist and Botanist of the Central Experimental Farm at Ottawa, which occupies twenty-four pages of the volume. After mentioning the chief insect attacks of the year, Mr. Fletcher gives an interesting and valuable account of the life-histories of the Hop-vine Borer (*Hydræcia immanis*, Guèn.), the Red Turnip-beetle (*Entomoscelis adonidis*, Fab.) the Western Blister-Beetle (*Cantharis Nuttalli*, Say.), and the Birch Bucculatrix (*B. Canadensisella*, Chamb.); in these there is much new and original matter as well as a summary of the previous observations of others. The identification of the Hop insect, which is also called from its mode of attack the "Collar-worm of the Hop," is particularly interesting. Its injuries have been observed for more than twenty years, but it was a long time before the moth was reared from the destructive larvæ and its identity established.

The most effective remedy for this insect appears to be the encouragement of the unsavoury skunk in the hop-yards. In the northern part of the State of New York and in Wisconsin, this animal has been found most useful from its habit of digging round the infested plants and devouring the worms. The turnip and blister-beetles referred to have been very destructive in the Northwest Territories, the latter attacking the Windsor Bean, while the Birch Bucculatrix has infested the trees in the neighborhood of Ottawa. Mr. Fletcher also describes several useful parasites which serve to keep in check the currant and willow saw-flies and other injurious insects. The remainder of his report is devoted to an account of the Potato-blight, which affects the leaves of the plant and the Potato-rot affecting the tubers, and a chapter on Lawn Grasses and Fodder plants.

CATALOGUE OF THE LEPIDOPTEROUS SUPER-FAMILY NOCTUIDÆ FOUND IN BOREAL AMERICA. By JOHN B. SMITH, Sc.D. (Bulletin No. 44 of the United States National Museum) Smithsonian Institution, Washington, 1893.

This volume of four hundred and twenty-four pages will be heartily welcomed by every student of the Noctuidæ of North America. It is not a mere list of species but a complete bibliographical and synonymical catalogue. The authority, date and reference, are given for each genus, and under each species are given the date, author and place of publication of the original description, followed by any other published references, the synonymy, habitat and where the type can be found. Any one who has attempted to keep a record of the published references to our Lepidoptera—and we have all been compelled to do so in some form or other—will appreciate the immense amount of labor that Prof. Smith has performed in the preparation of this work, and must feel heartily grateful that he has now relieved us of a task that few are competent to accomplish satisfactorily. The saving of time and the satisfaction of knowing that one is not now likely to overlook anything that has been published regarding a species are no small boons to the student. For a full explanation of the origin and purpose of the work we must refer the reader to Prof. Smith's somewhat lengthy preface, which will be found well deserving of careful perusal. The general index at the end of the volume makes the work complete, and we have no hesitation in saying that it is the most useful publication on the North American Noctuidæ that has yet been issued from the press. We trust that the author will before long be able to lay us under still greater obligations to him by the publication of his contemplated monograph of the whole of this family of moths.

BRIEF GUIDE TO THE COMMONER BUTTERFLIES OF THE NORTHERN UNITED STATES AND CANADA. By S. H. SCUDDER (Henry Holt & Co., 12 mo., pp. XI + 206, 1893).

It has been known for some time that Mr. Scudder has in preparation a Manual of the Butterflies of the Northern United States and Canada, similar to Gray's Manual of Plants, and all must agree that such a work is much needed. The present "Brief Guide" has, however, been produced in the meantime to meet a demand for something even less technical, by means of which boys and girls might be tempted to enter the ever charming fairy-land of science by having an easy way laid open before them. There are few objects in nature, which so soon thrust themselves upon the notice of young people as flowers and insects and of these none have been so useful as a first stepping stone or allurement to the realms of natural history as butterflies—"those winged creatures of beauty which add such a charm to the summer landscape."

There was not, however, until now, any work which could be placed in the hands of boys or girls who had caught a common butterfly, by means of which they could identify and find out something of the life-history of their newly-found treasure. This want Mr. Scudder has filled with his Brief Guide, in which he treats chiefly of those "butterflies—less than a hundred of them—which would almost surely be met with by any industrious collector in the course of a year's or two years' work in the more populous Northern States and in Canada." Should a young collector therefore be lucky enough to capture a butterfly not mentioned in the book, he may be sure that he has taken a rarity, which, as the author remarks, is "a discovery not always distressing to the amateur."

The introductory chapters, upon some of the points which will at once present themselves to a beginner are excellent—concise, clearly expressed and accurate, and treat of such subjects as :—What are butterflies, their structure, habits, variations and life-histories? There are three keys for identification, based on the perfect insect, the caterpillar and the egg, and pages 63 to 174 are taken up with short accounts systematically arranged of the insects treated of. There is a short glossary and an appendix giving instructions for collecting, rearing and studying butterflies.

On the whole this is a very useful little work, well prepared, convenient in size, well printed and well got up. It is, of course, arranged after the same system as Mr. Scudder's great work "The Butterflies of the Eastern United States and Canada," and many of the views there expressed are repeated here. The nomenclature is also the same, but the names more frequently used by other authors are also given. A good feature of the work is that the proper pronunciation of every name is shown by accents, and a popular English name is given for each species. The author's observatiens on dimorphism of some species, as of *Colias Eurytheme* and *Papilio Ajax* do not seem quite to agree with those published by Mr. W. H. Edwards. It would be difficult, however, to treat such subjects fully in the space allotted to each species in this Brief Guide, which, we think, all who use it will agree, is too brief, and they would like much more of it, of the same style. J. F.

FIG. 39.

THE LATE PROFESSOR WESTWOOD.

OBITUARY.

THE LATE PROFESSOR WESTWOOD.

We are much pleased to be able to give in this issue a likeness of the very eminent entomologist, Prof. Westwood, for which we are indebted to the kindness of the publishers of the *Illustrated London News*.

John Obadiah Westwood, M.A., F.L.S., etc., was born at Sheffield, England, on the 22nd of December, 1805, and died, shortly after completing his 87th year, on the 2nd of January last. His father was a die-sinker at Sheffield, but afterwards removed to Lichfield. When nearly 16 years of age he went to London to be articled to a solicitor, and though he devoted his attention more to the study of natural history than of law, he was admitted as a solicitor and became partner in a firm. Having some private means, which he augmented by writing and drawing, he was enabled to neglect his profession and give himself up almost entirely to entomology and archæology.

To quote Mr. McLachlan's obituary notice in *The Entomologist's Monthly Magazine*, "it was probably by his rare artistic talent that he acquired much of his justly great reputation. His drawings of insects were masterpieces of accuracy without the slightest attempt at effect and rapidly executed; few have equal'ed him in correct delineation. There certainly never has been an entomologist, who left behind him so much evidence, in practical work, of his ability to delineate insects, even to the most minute dissections. But Westwood was much more than an artist in entomology. There probably never has existed, and in the present state of the science there never can again exist, one who had so much general knowledge, both from personal investigation and a study of the works of others; one who was less of a specialist in the modern acceptation of the term. It is true he was a specialist, but it was in the way of taking up small groups in all orders and working them out thoroughly, his artistic talent giving merit and force to those small monographs. Under a somewhat brusque manner was concealed a hearty sympathy for all real workers, and if he offended, it was commonly in the way of pointing out to would-be introducers, etc., of supposed novelties, that some one or other had already made similar observations, his vast memory rendering him very dangerous in this respect. In society there could be no more genial companion, full of anecdote, but with small appreciation of humour. At home there could be no more generous host."

Professor Westwood was best known on this side of the Atlantic from his admirable work, "An Introduction to the Modern Classification of Insects," which was published in two volumes in 1839 and 1840. Every entomologist, worthy of the name, has no doubt made a study of this book, which still continues to be the best text-book on the subject in the English language. His sumptuous works on exotic insects, such as his "Arcana Entomologica," "Oriental Entomology," and his edition of Drury's "Exotic Insects," are also widely known, but his numerous contributions to various Natural History periodicals—a mere list of which would fill a volume—are not so familiar to our students. He was a most industrious and prolific writer, and made investigations in almost every family of insects in all the orders. His work is always characterized by its marvellous accuracy and patient elaboration of details, both of structure and habit; very rarely was he ever known to make a mistake.

He was actively associated with the Entomological Society of London from its foundation in 1833, and was for many years its secretary; subsequently he was elected President at three periods of two years each, and was made Honorary Life President when the Society celebrated its jubilee in 1883. He was a fellow of the Linnæan Society from 1827 and an Honorary or corresponding member of Scientific Societies all over the world.

In 1858 the Rev. F. W Hope, a wealthy amateur, who had been for years a warm friend and patron of Westwood, and had purchased his collections, gave them and his own to the University of Oxford, and founded a Professorship of Invertebrate Zoology, which bears his name. Westwood was appointed the first Hope Professor, and in consequence removed to Oxford, where he was a conspicuous figure in the University for five and thirty years.

Besides his entomological work he was a distinguished Archæologist and was widely known amongst those of kindred tastes by his investigations of the "Palæographia Sacra Pictoria," his "Lapidarium Walliæ" and "Facsimiles of the Miniatures and Ornaments of Anglo-Saxon and Irish Manuscripts." He formed a remarkable collection of carved ivories and inscribed stones, as well as of insects. In all respects he was a remarkable man, and accomplished by dint of steady industry and enthusiastic perseverance during a long life, an amount of valuable scientific work that has rarely, if ever, been excelled.

C. J. S. B.

The Late H. T. Stainton, F.R.S., etc.

Another of the leaders of English Entomology has also been taken from us in the person of Mr. Henry Tibbats Stainton, who died at his residence, Mountsfield, Lewisham, near London, on the second of December, 1892, in the 71st year of his age, after an illness of several months' duration.

His early education was received at home, and it was there no doubt, that he acquired his unusual knowledge of foreign languages which at that time were little taught in English Schools. After spending some time at King's College, London, he engaged in

business, and during the years devoted to commercial pursuits, he acquired the well-known habits of punctuality, order and accuracy, which distinguished him through life. He was always prompt in answering letters and most courteous as a correspondent. The writer had the pleasure of making his personal acquaintance at Mountsfield in 1864, and found him most kind and genial; he also met him at one or two meetings of the Entomological Society of London. Being a very energetic worker, he published a large number of articles in various Natural History magazines, and was himself the editor of the ten volumes of the *Entomologist's Weekly Intelligencer*; twenty volumes of the *Entomologist's Annual*, and joint editor from its foundation in 1864 to the end of his life (twenty-eight volumes) of *The Entomologist's Monthly Magazine*. His writings are for the most part devoted to the Micro Lepidoptera, in which group he was an acknowledged authority and possessed a world-wide reputation. Amongst his better-known works may be mentioned "Insecta Britannica Lepidoptera-Tineina," one volume, 1854; a "Manual of British Butterflies and Moths," two volumes, 1857-9, a model of clearness, conciseness and accuracy, and most useful to all collectors of British Lepidoptera; "The Natural History of the Tineina," thirteen volumes, 1855-73, printed in four languages—English, French, German and Latin—in which splendid work he was assisted by Zeller, Frey and Douglas; "The Tineina of North America," one volume, 1872, being the collected writings of the late Dr. Brackenridge Clemens, edited and annotated by Mr. Stainton; "The Tineina of Syria and Asia Minor," one volume, 1864; "The Tineina of Southern Europe," one volume, 1869.

To the *Tineina* he devoted most of his time and attention, and of them he was a diligent collector both in Britain and on the continent of Europe, and a painstaking student. The result of his work was a complete revision of the European Micro-Lepidoptera and the bringing into order and system of the various genera and species, to which little attention had been previously given. His name will long be held in high honour by entomologists everywhere, as one who devoted a long life to scientific investigation, and enriched the literature of his favorite pursuit with admirable works of great ability and unusual excellence, in which the literary portion was characterized by a charming and attractive style. C. J. S. B.

A Contrasted Summary of the Main External Characters of Butterflies in their Different Stages of Life.

By Samuel H. Scudder.

	Caterpillar.	Chrysalis.	Imago.
1. *Head as a whole*:	Independent; a globular case, its walls but little interrupted, except by sutures.	Soldered to thorax; mostly composed on an uninterrupted frontal plate.	Independent; a globose case, the sides almost entirely occupied by the compound eyes.
2. Eyes:	An arcuate series of simple ocelli, on the lower portion of the sides of the head.	A slightly convex plate on each side, largely overlaid by the antennæ, leaving exposed only an arcuate band, in which are faint traces of facets.	A convex, usually strongly convex or globose mass occupying the sides, delicately and minutely facetted to form compound eyes.
3. Antennæ:	Brief, four-jointed, free, terminating in a bristle seated on the third joint.	Long, multiarticulate, folded over and appressed to the breast.	Long, multiarticulate, apically clubbed, extended, free.
4. Mandibles:	Well developed, free moving, chizel-edged or denticulate jaws.	A pair of subtriangular plates, soldered to the body.	Minute triangular immovable plates soldered to the body; or else wanting.*
5. Maxillæ:	A papilla, seated on a mammilate elevation, with little motion.	A pair of long soldered ribbons, lying side by side along the middle line of the breast.	A free coiled tongue, composed of two opposite similarly lateral halves, the union of which, by interlocking plates on the inner surfaces, forms a hollow canal.
6. Maxillary palpi:	An inner and an outer, the former of one or two, the latter of three minute joints, seated on the crown of the maxilla.	[Not exposed on the surface.]	A single pair, at most two jointed, excessively minute, seated on the extreme outer base of the spiral tongue.
7. Labium:	Similar to the maxillæ but median, and bearing besides palpi on the outer sides, a central tube, the spinneret.	[Not exposed on the surface.]	Merely a slight chitinous ridge for the support of the palpi.
8. Labial palpi:	A minute two-jointed appendage at the outer sides of the labium.	[Not exposed on the surface, lying beneath the expanded base of the maxillæ, sheathless.]	A highly developed three-jointed appendage on each side of the head, heavily scaled, and protecting the coiled tongue, the second joint usually much the largest, the whole usually longer than the head.
9. *Thorax as a whole*:	By its contour not regionally distinct from the abdomen.	By its contour but little distinct regionally from either the head or the abdomen, but more so from the latter than from the former.	By its contour completely and equally distinct regionally from the head and the abdomen.
10. Its subdivisions:	Essentially similar, the anterior joint generally distinguished by differing armature or by the presence of extrusive glands, and always by the presence of spiracles which are wanting on the other joints.	The mesothorax much the largest, and the prothorax so reduced that its spiracles infringe upon the mesothorax, which, like the metathorax, is unprovided with them.	The proportions of the chrysalis maintained, the prothorax often becoming a mere appressed plate as seen from above, and apterous, while the other joints bear wings and lack spiracles.
11. Its surface and clothing:	More or less shagreened and bearing relatively sparse hairs, spines, tubercles or	Smooth or roughened, generally with scant and brief trichomes or none, generally	Smooth, with even surface and no elevations, but densely clothed with hairs and scales,

[fleshy filaments and sometimes extensile | with abrupt elevations, particularly in the |

	fleshy filaments and sometimes extensile glands.	with abrupt elevations, particularly in the middle of the mesonotum and at the base of the wings.	
12. Wings :	[Not visible externally, but existing as free internal membranous pads on the sides of the second and third segments.]	Folded over upon the breast as soldered chitinous pads, the front pair nearly covering the hinder.	Fully developed and free, covered with scales and often with hairs, especially at base and on the under surface.
13. Legs :	Five-jointed, tapering, smooth, partially chitinous members, no longer than the segments which bear them, and ending in a curved claw.	Many-jointed members, of which only the post-femoral parts are exposed, and of these only the first two pairs of legs (the third concealed beneath the wings) folded over upon the breast, to which they are soldered, unarmed.	Long and slender members, consisting of five very unequal parts, only the distal three elongated and the fifth broken up into five unequal joints, the last bearing a pair of claws and often other terminal structures, and at least the distal half of the whole leg more or less spined and often scaled.
14. Thoracic glands :	Very generally present as evaginable median organs on the first segment, in some cases for odorous defence, in others for unknown uses.	None known	None known, except such as have their opening in specially modified hairs or scales upon the wings or legs, when they appear to be always scent-organs.
15. *Abdomen as a whole* :	By its contour not regionally distinct from the thorax, being a succession of subequal rings, some of which bear fleshy, rather feebly jointed prolegs.	By its contour feebly distinct regionally from the thorax and at the base, beneath, overlaid by the thoracic appendages, but decidedly diminishing in size posteriorly ; the position of the prolegs of the caterpillar often marked by scars.	By its contour completely distinct regionally from the thorax, with no ambulatory appendages.
16. Its surface and clothing :	Similar to that of the thorax in the same stage.	Similar to that of the thorax in the same stage, but less frequently with special elevations, though these are sometimes very marked and most commonly longitudinally disposed.	Smooth and even, without elevations, densely clothed with scales.
17. The terminal segments :	Besides an anal pair of prolegs, the upper portion of the terminal segment forms an anal plate of different form from the other segments.	Developed as a specially constructed cremaster, usually armed with hooks for the suspension of the chrysalis.	These segments are developed in the female into specially formed parts serving as ovipositor and vaginal vestibule ; and in the male bear clasping organs both median and lateral of great diversity of form and armature, the latter often very complex.
18. Spiracles of abdomen:	Situated one pair to a segment on the sides of the first to the eighth segments, the last pair sometimes placed at a higher level than the others.	As in the caterpillar, excepting on the eighth segment, where the spiracles have disappeared.	As in the chrysalis.
19. Abdominal glands :	Often situated on some of the segments of the terminal half of the abdomen, either as median or paired organs, and subserving different uses, such as honey secreting or warning organs, or scent emitters.	None are known. †	Present occasionally, especially on the last two segments, generally as evaginable and odorous organs ; but apparently in no case as developments of those found in the larval stage, abdominal scent organs rarely or never occurring in the same insect in two stages.

* See Kellogg's recent discussion in the Kans. Univ. quart., ii. 55. † The chrysalis of one of the Heliconians is known to attract the attention of the mature opposite sex, but only shortly before the appearance of the imago, when any attracting odors must arise from glands, strictly imaginal, the odors piercing the chrysalis shell.