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Société Entomologique du Canada

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GUEST EDITORIAL

Integrated Pest Management — Common Sense Revisited

by
F.L. McEwen*

Entomology is a dynamic and exciting science and both its dynamism and its excitement flow jointly from the tremendous diversity of its subjects and the variety of interests and characteristics of those who pursue the study of insects as a career. Because of the diversity of insects an extensive taxonomy has developed but one could equally, and much more simply, devise a taxonomy that describes entomologists or the phases through which entomologists have taken their subject. Included in such a classification would be several genera of insect control specialists, the species of each genus having in common a belief that theirs is the only way to go. There would be also a number of subspecies that evolved rather quickly because of geographic and mental isolation.

This quick evolution of new species is one of the reasons entomologists are so dynamic. Witness the emergence of the pest management specialist and its subspecies, integrated pest management. This subspecies was first reported in Nova Scotia in the mid-fifties but has now spread to every province in Canada and is especially active on university campuses. What does this new subspecies do? Is it really new or just a resurgence of a variety that approached extinction and was not observed for a few decades? It would appear that a bit of both are involved.

The highly effective insecticides developed after World War II made insect control appear simple, so simple in fact that entomologists pursuing chemical methods of pest control were frowned upon by those species of entomologists involved in other pursuits. For a brief period perceptual isolation resulted and this continued until it became clear that neither the chemical control species nor the other species could do the job by themselves. A symbiosis was required and a niche developed in which a new subspecies, integrated pest management, could thrive.

The subspecies is characterized by some new tools for ecological studies, economic thresholds, a surfeit of computers, some software that seems to work, and a systems approach. This latter seems to involve repeated relations with other species. It is characterized also by high sounding dogma from high profile bodies. It is described by the FAO Expert Panel on Integrated Control as "A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and maintains the pest populations at levels below those causing economic injury." Dr. A.D. Pickett, the type specimen of the new subspecies characterized their goal "to make biological and chemical control additive factors rather than replacing one with the other."

There is every reason to believe that the subspecies of entomologists involved in integrated pest management will do much to bring better judgement to pest control strategies. Both new tools and new wisdom are needed. I suspect, however, they represent a reappearance of a variety of entomologists more common prior to World War II. One could find a lot of evidence to support this conclusion. I offer only one item, a quote from the Presidential Address of the 8th Annual Meeting of the American Association of Economic Entomologists. In 1896, C.H. Fernald said "I cannot rid myself of the conviction that in economic entomology, God helps those most who most help themselves — those who make themselves most conversant with His laws, as exhibited in the life and habits of the insects they have to deal with, as well as the climatic and other conditions which affect them, in fact the whole environment, and make the best possible use of this knowledge in their attempts to destroy insects or hold them in check."

Let's see to it that the subspecies does not again become threatened with extinction.

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LETTERS TO THE EDITOR

Oldest Scientific Society in Canada?

My purpose is to correct an impression conveyed in the programme of the meeting last autumn of the Canadian and American Societies. I believe the Royal Canadian Institute, founded in 1849 as the Canadian Institute is the oldest scientific society in Canada. Indeed nine men among them Professor Croft, professor of chemistry and natural philosophy, University of Toronto, and Rev. C.J.P. Bethune met at the Institute and decided on the formation of the Entomological Society of Canada (later to become the Entomological Society of Ontario). Rev. Bethune became the editor of the journal in 1868. Moreover the Canadian Institute began publishing its journal in the 1850's, several years before the Canadian Entomologist appeared. The latter is probably the oldest specialized journal.

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Presentations at Scientific Meetings

My experience at the Joint Meeting of the Canadian and American Entomological Societies leads me to the unhappy conclusion that, in comparison with ecologists and ornithologists, entomologists rank very poorly in terms of the average quality of paper presentation. I thought it might be useful, therefore, to abstract from a handout prepared by J.N.M. Smith of the Zoology Department at the University of British Columbia, on "Giving a Research Talk."

There really are only two simple rules for presentation, and probably everyone attending professional meetings knows them. And yet, at least one of these rules are violated in a majority of the talks I heard at the recent Toronto meeting. The basic rules are:

(1) Talks should not be read, and
(2) Slides should have large, legible print (not typewritten).

Speaking Skills. A good talk is presented to the audience, not the floor, wall, podium, or a written manuscript. Key features of good talks are *enthusiasm, audibility, simplicity, good timing and pace* — and *humor*. Practice on your friends. Their comments can be a great help and will build your confidence for talking to strangers.

Subject Matter. Develop a clear story-line. The components of a good talk are the same as for a good paper: *Statement of the problem, methods, important results, take home message.* Remember, if you find it difficult to decide how to interpret some result, an uninitiated audience will have even more difficulty. But don't be afraid to leave some loose ends; talks that provide all the answers can be boring. Your talk should establish what the next questions are.

Visual Aids. No matter how terrible a speaker you are or how nervous you get, it is relatively easy to prepare good visual aids. The following basic rules apply:

(a) Use *large* lettering. Check to see if your lettering can be read at the back of a large and poorly-blacked-out room. Freehand lettering is usually adequate, or you can use *Letraset*, a printing tape machine, or a stencil set. Freehand lettering which can be read is far superior to typed lettering which can't be seen beyond the speaker's podium.
(b) Keep each visual aid *simple* — a good rule of thumb is to make *one* point per aid. Only write as much as you need to make that point.
(c) Maximize the impact of each aid by the use of colour, arrows, cartoons, explanatory sketches, and clearly distinct symbols. Use only a few colours, and do so consistently throughout. Don't forget that some people are red/green colour blind.
(d) For graphs, label axes closely and incorporate symbol keys into the graph. Cartoon-like sketches as symbol keys can be very effective in reminding the listener what the lines or bars represent.
(e) *Do not use typewritten material*, especially if it is copied from a manuscript or book.

Small blocks of typing can make good slides, if copied at high magnification. use a 'jumbo' typewriter ball and a new ribbon.

(f) Avoid presenting large tables (more than 3 rows and 3 columns). These are nearly always the worst visual aids and yet they are used frequently at professional meetings.

(g) Leave an adequate margin around the edge of your material — if you crowd the screen, important bits may get cut off.

(h) Don't use figures or tables prepared for written publication. Simplify them, by leaving out detailed information and long captions, etc.

(i) Don't *read* large blocks of writing from the projector screen — if you do write statements on your aids, keep them short and try to talk informally about what you have written. Don't forget that your audience can read!

Better communication through better presentation might be a good motto for next year's meeting.

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The Awkward Syllable: Pronunciation of Scientific Names

At the combined meeting of the Entomological Societies of America, Canada and Ontario, November-December, 1982, I was dismayed by the almost incomprehensible rendering of scientific names by several of the speakers. In two cases I could not determine what insect, family, etc., was being discussed until the name or the specimen appeared on the projection screen.

Pronunciation of any scientific name is not difficult providing that simple rules are followed. The well-known text-book "An Introduction to the Study of Insects" by D.J. Borror and D.M. DeLong, 1954, pages 65-67 contains these rules.

The words which most people tend to mispronounce contain syllables ending with the letter "o" or where a vowel is used to connect two words. The problem appears to be lack of comprehension of what syllables are and how to break a word into syllables. Some speakers tend to break words between consonants, when the usual, but not universal, case is that the syllable ends with a vowel. The generic name "*Allonemobius*" (Allo-ne-*mo*-bi-us) seldom causes problems though the subfamily name "Gomphocerinae" (Gom-pho-*cer*-in-ae) is frequently mispronounced Gom-*phoc*-er-in-ae. The name "*Cecropia*" is usually correctly pronounced (Ce-*cro*-pi-a) and almost never (Ce-*crop*-ia). In these cases the accented syllable is the antepenultimate syllable, as the "o" in each is a long "o". Where the vowel is short as in *Philanthus* (Phi-*lan*-thus) the accented syllable is the penultimate one.

This short note is not intended as a course in pronunciation, but is written in hope that students and professionals alike will pay more attention to proper pronunciation of scientific names. Speakers who learn to pronounce names correctly will find that their efforts will be appreciated.

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The Support and Funding of Research in Entomology: The Entomological Rat Race

The support and funding of entomological research is a complex matter which is not necessarily perceived the same way by all interested parties. To make the point on the subject, speakers from Agriculture Canada, Canadian Forestry Service, one provincial

research organization, as well as Canadian and American universities were asked to present their respective views at the 1982 Annual Meeting of the Acadian Entomological Society. The quality of presentations, the interest of the participants and the appropriateness of the topic (at the present time) when resources for research are limited and competition for those resources is extremely fierce, incited us to summarize the symposium for The Bulletin. Although the summary borrow heavily from the speakers' presentations, the opinions expressed in it are those of the Executive. For a complete text, a limited number of the 1982 Proceedings of the Acadian Entomological Society are available free of charge upon request.

Since Confederation, research funding in Canada has been almost entirely a responsibility of the federal government. Federal decisions and long term plans have, therefore, a major impact on the relative importance of the various Canadian scientific disciplines now and in the future. In entomology, the federal government's "status quo" on positions is causing great concern. As outlined in the 1981 report of the President of the Entomological Society of Canada the federal government employed 350 entomologists in 1954 but fewer than 140 in 1980. This concern is not new. In 1971, the Presidents of the Entomological Society of America and the Entomological Society of Canada expressed their worries about the lack of positions for graduates in entomology.

More recently some people have argued that this perception of a drastic decline in support for entomology may not be so real. There are at least some organizations, the Canadian Forestry Service, for example, which during the last 10 years have maintained their level of funding for entomology and, in spite of severe adversity, have tempered their losses in people more in this field than perhaps any other. The CFS is even expected to make a complete recovery in terms of person years over the next five years. If one compares today's staffing with that of the 50's or 60's there appears to be a drastic decline in support. But can we actually compare today's situation and its array of diverse specialists with the 50's and their generalists (a majority being professional entomologists)? Up until about 10 years ago, virtually all insect problems were approached as exclusively entomological problems — for all intents and purposes the host plants were ignored. Now these situations are treated as integrated management problems. Also, most research organizations have narrowed their focus considerably in entomological research; today, research is restricted to a small number of major pests. There are valid arguments for and against this change of approach, but one thing is certain — it has undoubtedly contributed to the perception of decreasing support for entomology.

Although the support for entomology may not have declined in all areas, the lack of increase in funding during better times is reason enough for entomologists to wonder about the future of their research programs in today's economy of high inflation and a weak Canadian dollar. All entomological disciplines have advanced to the state where the technologies required to provide meaningful research data are no longer cheap. All would agree that entomologists with creative minds need more than a microscope and a goose-neck lamp. Changes are the order of the day. Changes are brought along by the profession itself as it adjusts to modern times and by society itself.

The responsibilities of research centers have been changed significantly in recent years. Entomological activities that are not considered as research, such as extension work and surveys, used to be included in the responsibility of federal governments, but these are now almost exclusively a provincial responsibility. This change in philosophy is not limited to Canada. In the United States, changes in the orientation of entomological projects can be expected to follow major shifts in funding priorities in the U.S. government. Research funding in agencies with a regulatory mission, such as the Environmental Protection Agency, will be greatly reduced; agencies, such as the Department of Defense, will have larger research budgets, and new opportunities will be available for entomologists working on disease vectors and insect problems in stored products; and agencies, such as the National Science Foundation, will continue to fare well. For entomologists working in basic areas, opportunities still exist for funding, but competition for funds will remain fierce. For those working in applied areas, or even basic areas on economically important insects, opportunities for funding may be reduced. It is unlikely that the NSF will provide funding for agencies such as agriculture, even for basic research related to applied problem areas.

There is an assumption in both Canadian and American administrations that industry will increase their support of basic and applied research as government support levels off or declines. This assumption is based on the fact that industry has been the beneficiary of research at universities where funding has been provided by government. Although industry may contribute more to some aspects of research at universities, such as genetic engineering, the current expectations for heavy involvement are likely to be overly optimistic. Furthermore, as with genetic engineering, industry is likely to concentrate assistance at those universities where critical masses of expertise now occur, and the richer universities will become richer.

Recent funding of universities by companies has raised a number of questions concerning university-industry relationships. State supported universities cannot operate in a veil of secrecy that often is required by industry; private universities are now examining the secrecy aspects of industry research in regard to the obligation of not having interference for the faculty in carrying out their primary responsibilities of teaching and research.

Within Agriculture Canada any strengthening of research capability will be related to the Agri-Food Strategy and the support it receives. The research needs have already been clearly articulated through the Canadian Agricultural Services Coordinating Committee. Each region has submitted a number of new initiatives which address priority research needs requiring new resource inputs; and support for increased entomological research is included in these proposals and initiatives. The development of integrated pest management systems and biological controls are obvious priority areas which will require significant infusions of new person years and dollars. Also, a new program entitled 'Management of Toxic Chemicals' has been approved recently. It will allow initiation of new work on the biologicals in 1982-83.

In forestry, the CFS is going back to Cabinet with a research and development proposal for resources to strengthen its research capability by 200 person years and $24.1 million over the next four years. A human resource package including such things as university grants, research contracts and a summer student program is also being proposed.

Thus the future outlook for research within the Canadian government is encouraging but unfortunately it is dependent on the economy of the country. The present message from the federal government is that much of any increased support for forestry and agricultural research and development will come via the contract research route or through support programs for industrial and university based research. In 1974 the Canadian government instituted a "make or buy" policy with respect to research. This meant that if resources were not available within its own establishments to carry out specific research projects, they would be contracted out to industry or universities. On the surface this appears to be a most rational policy and all concerned, universities included, are lining up at the trough. It has certainly encouraged more cooperative research efforts between industrial research organizations, universities and government departments in the production of new technologies. Many new research teams and cooperating agencies have been formed, and new grants have had a very positive effect on industrial research and development. Participation by industry further ensures the establishment and use of new technologies in the marketplace. However, it is possible that the long-term effects of this policy may be detrimental to research in the life sciences and to entomology in particular. One result of this policy has been that the federal government has not been increasing its recruitment of entomologists. This has subsequently resulted in a lack of young graduate students and postdoctoral fellows. These young people observe a moribund marketplace for their talents and enter into other professions. For a healthy research climate there must be adequate career opportunities for young people entering the field. Only then will the best of our young people enter the sciences.

Major support for basic research in Canadian universities comes from the Natural Sciences and Engineering Research Council (NSERC). A major program of NSERC is the operating grant program which is based solely on the competence of the researcher. Pressure on this source of funds is becoming increasingly intense as indicated by its 30% annual attrition rate in funding. The mission oriented strategic grants program was introduced in 1977 and now absorbs a substantial portion of NSERC's new research money. Although NSERC has stated that it will maintain its operating grants program, it is the concern of many that if the present rate of attrition continues, the operating grant program may eventually become restricted to those few Canadian scientists with major international reputations. In the U.S. outside sources of funding utilized by university faculties include NSF, USDA/competitive grants, USDA/AR cooperation agreements, USDA Forest Service, US Fish and Wildlife Service, various state agencies and university grants, plus commodity tax revenues.

Although support for entomology-related activities has been and will probably continue to be maintained in the future, the shifts in areas of responsibility as well as levels and sources of funding suggest a number of problems. Research programs can be dictated by priorities of the funding agency; these priorities may not fit the priorities of the entomologist, the department, or the university. For example, research stations have had to reorient programs so frequently in adhering to their legislated mandate to address the current problems of agriculture and forestry that they found it difficult to pursue basic scientific research.

For the entomologist, there are problems in attempting to develop a long-term research program with outside funding. Many of the available sources of funding are short-term, and in order to maintain a meaningful program and trained support staff the entomologist is required to spend much of his time preparing contracts and attending to administrative details, and less time in the actual conduct of research. There is some reporting required by all grants and contracts, but there is also the necessity to maintain a good publication record in order to

achieve professional advancement and ensure success in obtaining additional funding. Those engaged in such a rat race soon learn that today's science is a different ballgame than what they had envisioned in graduate school.

There is no definitive answer to the question "is the decline real or imaginary?" The network of funders and research "agencies" is so complex that no single answer can be adequate. One thing is certain, research both in general and within entomology, is becoming more and more competitive. From the above discussion it appears that entomology as a profession has insured its survival. But is it enough? Shouldn't it be a progressive profession? Individuals and societies will have to be more outspoken on the benefits of their research. Although it is notably difficult to identify and measure benefits derived from research it seems that this will be the key to entomological growth. Funds and support will go to those scientific specializations and individuals that can show not only effectiveness and ability to innovate but also greater returns on investment. It is time for entomologists to be less humble and let their success stories be known.

G.W. Wood, President
R.H. Parry, Vice-President
Gilles Boiteau, Secretary-Treasurer
A.R. Alford, Program Chairman
Acadian Entomological Society

ENTOMOLOGICAL SOCIETY OF CANADA
FINANCIAL STATEMENTS
DECEMBER 31, 1982

Auditors' Report

To the Members,
Entomological Society of Canada.

We have examined the balance sheet of the Entomological Society of Canada as at December 31, 1982 and the statement of revenue and expenditure for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion, these financial statements present fairly the financial position of the Society as at December 31, 1982 and the results of its operations for the year then ended in accordance with accounting principles as described in the notes to these financial statements, applied on a basis consistent with that of the preceding year.

Ottawa, Ontario,
March 23, 1983.

McCAY, DUFF & COMPANY
Chartered Accountants

Balance Sheet

AS AT DECEMBER 31, 1982

ASSETS	1982	1981
CURRENT		
Cash	$ 44,396	$ 76,893
Deposit certificates	40,968	—
Accounts receivable	36,052	84,505
Accrued interest	11,352	4,876
Prepaid expenses	5,191	3,998
	137,959	170,272
INVESTMENTS (note 2)	239,506	204,294
	$377,465	$374,566
LIABILITIES		
CURRENT		
Accounts payable	$ 8,486	$ 26,596
Due to Scholarship Fund	814	25
Deferred income	55,161	43,957
	64,461	70,578
EQUITY		
BALANCE — BEGINNING OF YEAR	303,988	308,788
Net revenue (expenditure) for the year	9,016	(4,800)
BALANCE — END OF YEAR	313,004	303,988
	$377,465	$374,566

Approved on behalf of the Board:

Governor

Governor

Statement of Revenue and Expenditure

FOR THE YEAR ENDED DECEMBER 31, 1982

	1982					Budget 1982			
	Canadian Entomologist	*Memoirs and Other Publications*	*Society*	*Total*	*Re-stated 1981 Total*	*Canadian Entomologist*	*Memoirs*	*Society*	*Total*
REVENUE									
Regular memberships	$ 7,560	$ —	$19,363	26,923	$ 26,229	$ 7,500	—	$ 18,750	$ 26,250
Student memberships	—	—	1,876	1,876	2,147	—	—	1,500	1,500
Sustaining memberships	—	—	100	100	300	—	—	—	—
Subscriptions	45,154	28,256	—	73,410	68,990	36,000	23,238	—	59,238
Reprints	14,507	—	—	14,507	15,381	13,800	—	—	13,800
Page charges	37,912	32,175	—	70,087	95,952	63,366	45,000	—	108,366
Back issues	7,424	—	—	7,424	2,742	2,500	—	—	2,500
Sales of Memoirs	—	5,579	—	5,579	327	—	2,100	—	2,100
Sales of Arctic Arthropods	—	3,348	—	3,348	3,561	—	6,500	—	6,500
Interest	—	—	34,792	34,792	34,930	—	—	30,000	30,000
Gain on currency exchange	—	—	6,565	6,565	10,618	—	—	—	—
Government grant	27,000	—	—	27,000	27,000	—	—	—	—
Miscellaneous income	1,737	—	3,844	5,581	1,044	—	—	700	700
	141,294	69,358	66,540	277,192	289,221	123,166	76,838	50,950	250,954
EXPENDITURE									
Publishing and mailing costs	91,745	48,214	—	139,959	146,176	101,000	60,000	—	161,000
Reprint costs	9,214	—	—	9,214	8,582	7,000	—	—	7,000
Publishing costs Arctic Arthropods	—	—	—	—	25,157	—	—	—	—
Bulletin publishing and mailing	—	—	12,654	12,654	10,437	—	—	10,000	10,000
Salaries and benefits	43,854	5,891	6,439	56,184	58,017	39,575	5,283	5,500	50,358
Office	7,500	901	7,500	15,901	14,972	6,900	200	6,900	14,000
Professional fees	1,600	—	1,600	3,200	1,700	600	—	600	1,200
Prizes, awards, brochure, etc.	—	—	1,205	1,205	1,152	—	—	1,000	1,000
Honoraria	1,200	—	1,700	2,900	2,900	1,200	—	1,700	2,900

Committees:									
Photo Salon	—	—	—	—	148	—	—	—	—
Education	—	—	471	471	104	—	—	1,000	1,000
Science Policy	—	—	1,846	1,846	1,540	—	—	1,000	1,000
Common Names	—	—	224	224	25	—	—	100	100
Employment	—	—	633	633	353	—	—	600	600
Membership	—	—	676	676	—	—	—	3,000	3,000
Finance	—	—	63	63	32	—	—	100	100
Support of other organizations	—	—	3,410	3,410	3,826	—	—	4,225	4,225
Annual Meeting:									
Grant	—	—	350	350	2,000	—	—	2,500	2,500
Honorees	—	—	1,917	1,917	299	—	—	1,200	1,200
Governing Board:									
Interim meeting	—	—	2,539	2,539	2,774	—	—	1,500	1,500
Annual meeting	—	—	11,629	11,629	10,902	—	—	14,000	14,000
Other meetings	—	—	2,361	2,361	2,787	—	—	1,300	1,300
President's discretionary expense	—	—	235	235	—	—	—	750	750
General	—	—	605	605	138	500	—	500	1,000
	155,113	55,006	58,057	268,176	294,021	156,775	65,483	57,475	279,733
NET REVENUE (EXPENDITURE) FOR THE YEAR	($ 13,819)	$14,352	$ 8,483	$ 9,016	($ 4,800)	($ 33,609)	$11,355	($ 6,525)	($ 28,779)

Notes to Financial Statements

DECEMBER 31, 1983

1. SIGNIFICANT ACCOUNTING POLICIES

(a) The Society uses the accrual method of accounting.
(b) Furniture and equipment purchases have been expensed in the year of acquisition.
(c) Entomological Society of Canada is incorporated without share capital under Part II of the Canada Companies Act and is non taxable.

2. INVESTMENTS

	1982	1981
Bonds (at cost — market value 1982 — $193,163., 1982 — $173,285.)	$199,506	$204,294
Guaranteed investment certificate — 16.5%, 1984	40,000	—
	$239,506	$204,294

3. COMPARATIVE FIGURES

Certain comparative figures have been reclassified to conform with current presentation.

NOTICE OF ANNUAL BUSINESS MEETING

The Annual Business Meeting of the Entomological Society of Canada will be held Tuesday, October 4, 1983, at the Sheraton Hotel, Regina, Saskatchewan, at 3:30 p.m.

Matters for the consideration of this meeting or of the Governing Board meeting, to be held on October 1 and 2, 1983 at Regina, should be sent to the Secretary, Dr. H.G. Wylie, Research Station, Agriculture Canada, 195 Dafoe Road, Winnipeg, Manitoba R3T 2M9.

La Réunion Annuelle d'Affaires de la Société Entomologique du Canda aura lieu le mardi, 4 octobre 1983 à l'Hôtel Sheraton, Régina, Saskatchewan. Ceux qui désirent soumettre des propositions pour cette Réunion ou au Conseil de Direction, voudront bien les envoyer à l'adresse donnée plus haut.

COMMITTEES

Science Policy Committee: An Update & A Request for Assistance

The Science Policy Committee, under the direction of the Governing Board, maintains a Dossier of important entomological subjects in need of study. This enables the Society to develop a strong factual base about problems of high entomological priority in Canada. In addition to the Dossier, the SPC also maintains a listing of neglected areas of research. Items on this second list are available for transfer to the Dossier as circumstances permit. Recommendations to the Governing Board for preparation of a brief will depend on the priority attached to the proposal and on the level of these activities that the Society can sustain.

The Science Policy Committee wishes to advise members of ESC about these lists, and solicits additional subjects for inclusion. Please help us keep these lists up-to-date. The intention of SPC in making this request is to give members an opportunity to participate in improving the flow of information available to the Governing Board. The better informed the Board is, the more effective it is likely to be in acting on behalf of entomology and entomologists in Canada.

Each submitted proposal should contain a title, and a statement outlining the importance of the topic.

Proposed subjects currently on the Dossier include:

1) Biological control of insect pests and noxious weeds (by insects) in Canada: organization and implementation of research.

Action — This item went to the Board as a result of a resolution put forward at the annual meeting in 1981. A small steering committee, chaired by Dr. J.E. Laing, was appointed in 1982 to draw up a proposal for short-term funding from the Federal Government. However, no further action will be taken till the publication of a C.A.B. report entitled: "Biological Control Programs Against Insects & Weeds in Canada. 1969-1980. Part I. Agricultural Insects", is released.

2) Microbial insecticides: their registration and use in agriculture and forestry.

Action — A special study committee on microbial insecticides, under the Chairmanship of Dr. O.N. Morris, was organized in March 1983. The mandate was expanded to include public and animal health concerns, and the study is expected to be completed in late 1984. Microbial insecticides will include bacteria, fungi, microsporidia, nematodes and other related groups.

3) Pest Control Products Act: revision in the light of current ideas about pest management.
No action taken to date.

4) Provincial regulations for the registration of pest control operators and dealers in agricultural chemicals: A comparative study.

Action — the President will contact the Regional Societies and seek their assistance in instituting such a study.

Proposed titles for the list of neglected areas of research are:

1) Cold-hardiness of northern insect species
2) Role of terrestrial arthropods in decomposition of plant litter
3) Insect pathology
4) Insect transmission of disease
5) Insect resistance to insecticides
6) Taxonomy of insect larvae
7) Insect fauna of sphagnum bogs

Please send your proposals to: Ray F. Morris, Chairman
Science Policy Committee, E.S.C.
Research Branch, Agriculture Canada
P.O. Box 7098
St. John's, Newfoundland
A1E 3Y3

Membership Committee

The Honorary Members of the Society are R.E. Balch, J.S.L. Daviault, R. Glen, G.P. Holland, G.F. Manson, J.H.H. Philips, A.D. Pickett, M.D. Proverbs and A.G. Robinson.

The By-Laws permit the election of one more Honorary Member by the ballot in 1984. Any five active members may submit, for consideration by the Membership Committee, the name of a member who has made an outstanding contribution to the advancement of entomology. The Committee may nominate members for election to Honorary Membership.

Submissions, accompanied by supporting statements (biography and recent photograph), should be sent to the undersigned, for forwarding to the Committee. Previous submissions will not be considered by the Committee unless they are resubmitted. The committee determines by concensus the nominations to be placed on the ballot that is sent to all members.

Les Membres Honoraires de la Société sont R.E. Balch, J.S.L. Daviault, R. Glen, G.P. Holland, G.F. Manson, J.H.H. Philips, A.D. Pickett, M.D. Proverbs and A.G. Robinson.

Les status permettent l'élection d'un autre Membre Honoraire au prochain scrutin de 1984. Tout groupe de cinq membres actifs peut soumettre au comité des membres le nom d'un sociétaire qui à fait une contribution exceptionnelle à l'avancement de l'entomologie. Le Comité des Membres peut proposer des sociétaires pour élection comme Membre Honoraire.

Les nominations, accompagnés de documents pertinents (biographie et photos récente) doivent parvenir au sous-signé pour soumission eventuelle au Comité. Les nominations antérivres ne seront pas considérées par le Comité et doivent être soumises à nouveau. Le Comité décide par consensus des nominations présentés sur le bulletin de vote et envoyé à tous les membres.

Bryan Frazer
Agriculture Canada Research Station
6660 N.W. Marine Drive
Vancouver, B.C.
V6T 1X2

Fellowship Committee

The Fellowship Selection Committee has nominated, and the Governing Board has approved the following candidates as Fellows of the Entomological Society of Canada.

A.E.R. Downe	— Kingston, Ontario
J.E. McFarlane	— Ste. Anne de Bellevue, P.Q.
R.D. McMullen	— Summerland, B.C.
M.J. Tauber	— Ithaca, New York
H.K. Townes	— Ann Arbor, Michigan

R.A. Brust
Chairman,
Fellowship Selection Committee

Scholarships Committee: The ESC Scholarship Fund

During 1982, 58 donations were received from 52 individuals, for a total of $1,413. The Scholarship Fund now contains $26,212, which generates about $3,000 interest annually. This is enough to award at least two $1,000 postgraduate scholarships annually. Since its beginning six years ago, 10 scholarships have been awarded, one each for the first two years and two in each of the other years.

Last year the majority of the donations accompanied payments of membership dues, in fact, several members paid in U.S. dollars and requested that the exchange be credited to the Scholarship Fund with the result that about $45 was added. This is a unique way to increase the fund.

Also last year nearly $500 was donated in memory of John McLintock, Gordon Hobbs, and Dewey Soper. What better way than to make a donation to the memory of someone? In fact, Elizabeth Hobbs (Mrs. Gordon) recently wrote:

"It is my hope also that others will consider donating to the Scholarship Fund in lieu of flowers [as requested by the family of John McLintock] and I also believe that the idea of doing so is becoming more prevalent. A *Living Memorial* in memory of our many talented scientists is most appropriate especially in these hard economic times."

Thanks to all of the donors listed below; many have donated in other years and your support is really appreciated by the recipients.

Anonymous (1 individual)
Allen, Phyllis J. Winnipeg, Man.
Arnold, John W., Chelsea, Que.
Ball, G.E., Edmonton, Alta.
Becker, E.C., Ottawa, Ont.
Bordon, J., Burnaby, B.C.
Boiteau, G., Fredericton, N.B.
Brooksbank, A. & L., Winnipeg, Man.
Byers, G.W., Lawrence, KS
Cannings, S.G., Vancouver, B.C.
Casey, Eileen D., Brooklyn Center, MN
Chenier, R., Ottawa, Ont.
Cloutier, C., Quebec, Que.
Craig, D.A., Edmonton, Alta.
Davies, D.M., Hamilton, Ont.
Demars, C.J., Jr., Berkeley, CA
Doane, J.F., Saskatoon, Sask.
Downes, J.A., Ottawa, Ont.
Fedde, G.F., Athens, GA
Fredeen, F.J.H., Saskatoon, Sask.
George, J.A., Mt. Brydges, Ont.
Gooding, R., Edmonton, Alta.
Gyrisco, G., Ithaca, NY
Gwynne, D.T., Needlands, Australia
Hidaka, T., Kyoto, Japan
Holzbach, J.E., Kinmount, Ont.
Hobbs, Elizabeth, Lethbridge, Alta.
Hudson, Anne, Ottawa, Ont.
Klimaszewski, J., Ottawa, Ont.
Loschiavo, S.R., Winnipeg, Man.
Mair, W.W., Victoria, B.C.
McIver, Susan B., Toronto, Ont.
McLean, J.A., Vancouver, B.C.
McLintock, A.B., Vancouver, B.C.
McLintock, the late J.R., Victoria, B.C.
McNeil, J., Quebec, Que.
Morris, R.F., St. John's, Nfld.
Pak, Moo-jae, Muncie, IN
Price, P.W., Flagstaff, AZ
Read, D.C., Charlottetown, P.E.I.
Rosenberg, D., Winnipeg, Man.
Salkeld, E. Helen, North Gower, Ont.
Stevenson, A.B., Vineland Station, Ont.
Stock, A.J., Smithers, B.C.
Turnock, W.J., Winnipeg, Man.
Volney, W.J.A., Berkeley, CA
Wallace, M.C., Winnipeg, Man.
Whitman, R.J., Kentville, N.S.
Wiggins, G.B., Toronto, Ont.
Wigmore, R.H., Yarker, Ont.
Wood, D.L.,
Wood, P.W., Castelar, B.C.

Insect Common Names and Cultures Committee

The list of Laboratory Cultures of Insects and Other Arthropods in Canada is to be revised in 1983. Those who participated in the 1981 revision will be contacted directly. Any others who have cultures and are willing to provide nucleus cultures of them are urged to contact the undersigned. The 1981 list is still available on request and an announcement will be made when the 1983 one is printed.

J.S. Kelleher
SIRS — Research Program Service
Agriculture Canada
Ottawa, Ontario K1A 0C6

OFFICERS OF AFFILIATED SOCIETIES

Entomological Society of Ontario

President:	Dr. R.L. Edwards
Vice-President:	Dr. J.E. Laing
Secretary:	Dr. M.K. Sears Department of Environmental Biology University of Guelph Guelph, Ontario N1G 2W1 Tel: 519-824-4120 (Ext. 3567)
Treasurer:	Dr. G.A. Surgeoner Department of Environment Biology University of Guelph Guelph, Ontario N1G 2W1 Tel: 519-824-4120 (Ext. 3966)
Editor (Proceedings):	Dr. C.R. Ellis
Regional Director to ESC:	Dr. R. Harmsen

NEWS OF ORGANIZATIONS

World Health Association's Onchocerciasis Control Program

Onchocerciasis, commonly known as river blindness, is a disabling disease that has brought blindness to tens of thousands in tropical Africa, Yemen and parts of South and Central America. More than twenty million persons in the world are infected with the filarial worm *Onchocerca volvulus* which causes the disease. The principal vector is the *Simulium damnosum* (blackfly) complex.

The Onchocerciasis Control Program (OCP) is funded by a number of countries, including Canada, and the current program involves parts of six West African countries and covers more than 800,000 square kilometers. The control operations are conducted all year with headquarters and a supporting research program at Ougadougou, Haute Volta.

The entomological input into the OCP is mainly for vector control and for research aimed at improving that control. Vector control involves the application of insecticide from aircraft to the insect breeding sites. Although this seems straightforward, it is, in fact, a very complex and difficult program with many biological, geographical and hydrological problems. There are vector complexities and insecticide resistance and vector re-invasion problems also.

The OCP is putting considerable emphasis on the determination of alternative insecticides, the study of the vector re-invasion problem and the possible addition of adult insect control to the program. There is also research on non-traditional larval control techniques.

For information on positions with the OCP, please see the Positions Available section of the Bulletin.

Additional information regarding the OCP may be obtained from Dr. E.M. Samba, Director, Onchocerciasis Control Programme, Organization Mondiale de la Santé, BP 549, Ouagadougou, Haute Volta, or from Ian Lindsay, Member, WHO Expert Advisory Committee, OCP, 1357 Sangster Road, RR1, Sidney, B.C. V8L 3R9.

International Commission on Zoological Nomenclature

Reference: ITZN 11/4 (A.N. (S.) 125) 5 April 1983

The Commission hereby gives six months notice of the possible use of its plenary powers in the following cases, published in the *Bulletin of Zoological Nomenclature*, volume 40, part 1, on 29 March 1983, and would welcome comments and advice on them from interested zoologists.

Correspondence should be addressed to the Secretary at the address below, if possible within six months of the date of publication of this notice.

Case No.

1688 *Pseudopontia* Plötz *v. Gonophlebia* Felder (Insecta, Lepidoptera): settlement of case.

2223 Request for a ruling to correct homonymy in names of the family-groups based on *Myrmecia* (Insecta) and *Myrmecium* (Arachnida).

2269 On family-group names based on *Eurhin, Eurhinus* and *Eurhynchus* (Coleoptera).

2389 *Myzus festucae* Thobald, 1917 (Insecta, Aphidoidea): proposed conservation.

2153 *Calaphis* Walsh, 1862 and *Callaphis* Walker, 1870 (Insecta, Hemiptera, Aphididae): proposals to remove the confusion.

2373 *Uroplat* — as the stem of family-group names in Amphibia and Insecta (Coleoptera): proposals to remove the homonymy.

2358 *Oeciacus vicarius* Horvath, 1912 (Insecta, Hemiptera, Cimicidae): proposed conservation.

Reference: ITZN 59 5 April 1983

The following Opinions have been published by the International Commission on Zoological Nomenclature in the *Bulletin of Zoological Nomenclature*, volume 40, part 1, on 29 March 1983:

Opinion No.

1239 (p. 25) *Attelabus* Linnaeus, 1758 (Insecta, Coleoptera): type species designated.

1240 (p. 27) *Hesperiidae* Latreille, 1809 (Insecta, Lepidoptera): added to Official List.

1244 (p. 37) *Stethaspis* Hope, 1837 (Coleoptera, Scarabaeidae): designation of type species.

The Commission regrets that it cannot supply separates of Opinions.

R.V. Melville (Secretary)
British Museum (Natural History)
London SW7 5BD
England

MEETING ANNOUNCEMENTS

Joint Meeting *Entomological Society of Canada* and *Entomological Society of Saskatchewan*, at the Sheraton Centre, Regina, on 3-5 October 1983.

CONTACT: P.W. Riegert, Department of Biology, University of Regina, Regina, Saskatchewan S4S 0A2. Telephone (306) 584-4224.

Joint Meeting *Entomological Society of Canada* and *Acadian Entomological Society*, at the Algonquin Hotel, St. Andrews, New Brunswick, on 30 September - 4 October, 1984.

CONTACT: G. Boiteau, Agriculture Canada Research Station, P.O. Box 20280, Fredericton, New Brunswick E3B 4Z7.

Entomological Society of Manitoba, Annual Meeting at the Freshwater Institute, Winnipeg, on 3-4 November, 1983.

CONTACT: G.H. Gerber, Agriculture Canada Research Station, 195 Dafoe Road, Winnipeg, Manitoba R3T 2M9. Telephone (204) 269-2100.

Canadian Federation of Biological Societies Annual Meeting, at the University of Ottawa, on 13-27 June, 1983.

CONTACT: G.R.F. Davies CFBS P.O. Box, Sub. 6, Saskatoon, Saskatchewan S7N 0W0. Telephone (306) 343-7384.

Canadian Pest Management Society Annual Meeting, in Truro, Nova Scotia, on 11-13 July, 1983.
CONTACT: R.J. Whitman, Nova Scotia Agriculture and Marketing Research Station, Kentville, Nova Scotia B4N 1J5.

North American Plant Protection Organization Conference, at the Banff Springs Hotel, Banff, Alberta, on 10-14 October, 1983.
CONTACT: Wes Reid, Plant Quarantine, Agriculture Canada, Ottawa, Ontario K1A 0C6. Telephone (613) 995-7900.

Entomological Society of America Annual Meeting, in Detroit, Michigan, on 28 November - 2 December, 1983.
CONTACT: W. Darryl Hansen, Entomological Society of America, 4603 Calvert Road, College Park, MD 20740, U.S.A.

Society for Invertebrate Pathology Annual Meeting at Ithaca, N.Y., on 7-11 August, 1983.
CONTACT: Donald W. Roberts, Insect Pathology Research Centre, Boyce Thompson Institute, Tower Road, Cornell University, Ithaca, N.Y. 14853, U.S.A. Telephone (607) 257-2030.

Joint Meeting *American Phytopathological Society, Society of Nematologists, Mycological Society of America*, at Iowa State University, on 26-30 June, 1983.
CONTACT: APS Headquarters, 3340 Pilot Knob Road, St. Paul, MN 55121, U.S.A. Telephone (612) 454-7250.

American Institute of Biological Sciences, Annual Meeting at the University of North Dakota, Grand Forks, North Dakota, on 7-11 August, 1983.
CONTACT: Mohan K. Wali, Department of Biology, The University of North Dakota, Grand Forks, ND 58202, U.S.A. Telephone (701) 777-3026

Society of Environmental Toxicology and Chemistry, Annual Meeting at the Hyatt Regency Hotel, Crystal City, Arlington, Virginia, on 6-9 November, 1983.
CONTACT: SETAC, POB 352, Rockville, MD 20850, U.S.A. Telephone (301) 468-6704.

CANUSA Workshop on New and Improved Techniques for Monitoring and Evaluating Spruce Budworms, at the Holiday Inn, 1068 Williston Road, Burlington, Vermont, on 13-15 September, 1983.
CONTACT: D.G. Grimble, USDA Forest Service, 370 Reed Road, Broomall, PA 19008, U.S.A. Telephone (215) 461-3016.

IV International Symposium on Trichoptera, at Clemson University South Carolina on 11-16 July, 1983.
CONTACT: J.C. Morse, Department of Entomology, Fisheries and Wildlife, Clemson University, SC 29631, U.S.A.

VII International Symposium of Odonatology, in Calgary, Alberta on 14-21 August, 1983.
CONTACT: Dr. Gordon Pritchard, Department of Biology, University of Calgary, Calgary, Alberta T2N 1N4.

III European Ecological Symposium, Plant-Animal Interactions, at University of Lund, Sweden, on 22-26 August, 1983.
CONTACT: III European Ecological Symposium, Ecology Building, S-223 62 Lund, Sweden.

International Conference on Insect Neurochemistry and Neurophysiology, at College Park, Maryland, on 1-3 August, 1983.
CONTACT: ICINN, Insect Reproduction Laboratory, Agricultural Research Centre, USDA, Building, 306, Beltsville, MD 20705, U.S.A.

World Soybean Research Conference III, at Iowa State University, Ames, Iowa, on 12-17 August, 1983.
CONTACT: Walter R. Fehr, Department of Agronomy, Iowa State University, Ames, IA 50011, U.S.A.

IV International Meeting of Coccidology, at the Hungarian Academy of Sciences, Budapest, on 15-20 August, 1983.
CONTACT: F. Kozar, Research Institute of Plant Protection, Herman Otto Ut 15 Pf 102, Budapest 14, H1515-Hungary, or Michael Kosztarab, Entomology Department, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, U.S.A.

III International Working Conference on Stored-Product Entomology, at Kansas State University, Manhatten, Kansas, on 23-27 October, 1983.
CONTACT: Conference Office, Kansas State University, Division of Continuing Education, 1623 Anderson Avenue, Manhatten, KS 66506, U.S.A.

XVII International Congress of Entomology, in Hamburg, West Germany, on 20-26 August, 1984.
CONTACT: Dr. Thomas Tischler, Zoologisches Institut der Universitat, Abt. Angewandt Okologie Kustenforschung, Biologiezentru, Olshansenstr. 40/60, D-2300 Kiel 1, West Germany.

III International Mycological Congress, in Tokyo, on 28 August - 3 September, 1983.
CONTACT: Professor K. Tubaki, Secretary-General, c/o International Congress Service Inc., Chidusen Building SF, 2-7-4 Nikombashi, Chuo-ku, Tokyo, Japan.

IV International Congress of Plant Pathology, in Melbourne, on 17-24 August, 1983.
CONTACT: Dr. G. Weste, Department of Botany, University of Melbourne, Parkville, Victoria 3052, Australia.

X International Congress of Plant Protection, in Brighton, Sussex, U.K., on 20-25 November, 1983.
CONTACT: Mrs. R.A. Bishop, Frank Bishop (Conference Planners Ltd.), 144/150 London Road, Croydon, Surrey CRO 2TD, U.K.

XI International Congress for Tropical Medicine and Malaria, in Calgary, Alberta, on 16-22 September, 1984.
CONTACT: Secretariat XI ICTMM, University of Calgary, Calgary, Alberta T2N 1N4.

COURSE

Scanning Electron Microscopy and X-Ray Microanalysis: Theory and Practice, at Lake Mohonk, New Paltz, New York, on 17-21 October (Materials Science), 24-28 October (Biology and Medicine), 24-28 October (Advanced SEM/X-Ray Microanalysis), 1983.
CONTACT: A.V. Patsis, Director, Materials Research Laboratory, State University of New York, New Paltz, NY 12561, U.S.A. Telephone (914) 257-2175.

PUBLICATIONS

The Canadian Entomologist: Editorial Tips

For the second consecutive year, "Instructions to Authors" have been published in the January issue in both English and French. Most authors observe them carefully, but some still do not. Much time is saved for everybody when they do.

It would make editing a little easier if two common problems were avoided. The verb "to vary", the adjective "various" and the noun "variation" are frequently used when "to differ", "to range", "different", "ranging", "variation" and "range" are meant; also, the adjectives "varying" and "various" are not synonyms but are frequently confused. The other problems seem to have begun with "and/or" which is described by one expert on American-English usage as an ugly combination best confined to business and legal documents. That this expression is found in the dictionary is not justification for its use because lexicographers only cite usage — they do not recommend it. The virgule is variously used in manuscripts received to substitute for "and/or", "and", "or", a hyphen, "divided by" and "per"; it should be reserved for the last two because the meaning is often uncertain in other uses.

The use of "respectively" constructions should be reserved. Many writers are addicted to this word, which frequently results in awkward constructions or ambiguity. Only occasionally does it simplify or clarify meaning.

Authors frequently indicate uncertainty about what is citeable. Policy differs among journals but as a general rule it is unfair to cite material not available to the reader. Unpublished material should not be cited except as personal communications, which I discussed in the March 1983 Bulletin. The full name should be given with the address as a footnote. One's own unpublished data may be referred to, but not in a formal citation. In fact, much space in journals could be saved by omitting peripheral information that could be offered to readers "on request".

The abbreviation for degree-days suggested in my remarks last month (*Bulletin* 15 (1):43) may be further improved by using a superscript to indicate an upper development threshold. Thus $10^{\circ}D_{9}^{30}$ means ten degree-days between nine and thirty degrees Celcius.

To complete this potpourri of editorial tips, the manuscript number assigned to your paper is extremely important to us and should always be cited. It saves us time.

D.C. Eidt
Scientific Editor
The Canadian Entomologist

Book Reviews

Darryl T. Gwynn and Glenn K. Morris, Editors, 1983 (1982). *Orthopteran Mating Systems: Sexual Competition in a Diverse Group of Insects*. Westview Press Inc., Frederick A. Praeger, Boulder, Colorado. Soft cover, xvi + 376 pp. $ U.S. 30.00.

This volume contains the papers read at a symposium held at the 1980 Annual Meeting of the Entomological Society of America in Atlanta, Georgia, in November of that year. The "official" date of publication should note that it was first offered for sale (and thereby published) in December, 1982 (at the Joint Entomological Societies' Meeting in Toronto). The title itself is also somewhat misleading, for the contributions relate not only to saltatorial orthopteroids (including Grylloptera, or Ensifera, to which the bulk of the papers refer) but also to stick-insects (Cheleutoptera or Phasmatoptera) and cockroaches (Dictyoptera, Blattodea) — one contribution for each — which are "orthopteroid" but scarcely "orthopteran".

The book begins with a brief general introduction by the Editors, who include a table of "families" of Ensifera (Grylloptera) and Caelifera (Orthoptera, *sensu stricto*), which would have been better omitted as, not only is it out-of-date (from this reviewer's point of view at least), but, with one exception, it includes only groups found in Australia! Admittedly all the groups discussed (and several that are not) appear in the table. The introduction is followed by 16 papers divided into four groups: Communication, Competition for Mates, Choice of Mates, and Mating Systems in Selected Groups. With reference to the last of these one suspects that there was, in fact, no selection by the organizers of the symposium, but rather that the choice of groups discussed depended entirely upon the interests of available contributors.

The titles of the included papers are as follows:

A. *Communication:*

1. "Adaptative significance of Chorusing with Special Reference to the Orthoptera" by M.D. Greenfield and K.C. Shaw — based mainly on a number of species of Tettigonioidea (mostly American), one N. American grylloid and one European acridid.
2. "Mating Systems and Signals in Crickets" by C.R.B. Boake — members of 7 higher taxa of Grylloidea and Gryllotalpoidea are discussed.
3. "Diel Patterns of Calling in Nocturnal Orthoptera" by T.J. Walker — Grylloidea, Gryllotalpoidea and Tettigonioidea, with some reference also to cicadas and lampyrid beetles.
4. "Random Noise and Congeneric Discrimination in *Conocephalus* (Orthoptera: Tettigoiidae)" by G.K. Morris and J.H. Fullard — several species referred to (reviewer's preferred classification Grylloptera: Conocephalidae!).

B. *Competition for Mates:*

5. "Male Agression and Female Choice in a Field Cricket (*Teleogryllus oceanicus*): The Importance of Courtship Song" by T. Burk — a northern Australian and Pacific island gryllid.
6. "Aggression and Mating Behavior in the Stenopelmatidae (Orthoptera, Ensifera) with Reference to New Zealand Wetas" by L.H. Field and G.R. Sandlant — although the American genus *Stenopelmatus* (Stenopelmatidae, *s. str.*) is discussed, the paper deals principally with the New Zealand genera of Mimnermidae (= Henicidae), *Deinacrida* and *Hemideina* (Deinacridinae), though *Zealandosandrus* and *Hemiandrus* (Mimnerminae = Henicinae) are also referred to. Cave *weta (sic)*, Rhaphidophoroidea — Macropathidae, are not mentioned.
7. "Predation and Sperm Competition in the Evolution of Coupling Durations, Particularly in the Stick Insect *Diapheromera veliei* by J. Sivinski — a widely distributed North American heteronemiid; various other Cheleutoptera are referred to.
8. "Male Spacing Behavior in the Tettigoniidae: An Experimental Approach" by W.J. Bailey and D.R. Thiele — very largely concerns the western Australian conocephalid (copiphorine) *Mygalopsis marki*.

C. *Choice of Mates*

9. "Calling Songs and Mate Choice in Mole Crickets" by T.G. Forest — deals with Gryllotalpidae occurring in Florida.
10. "Pair Formation in the Katydid *Orchelimum nigripes* (Orthoptera: Tettigoniidae)" by M.N. Feaver — the study of this conocephalid was carried out in Michigan; comparisons are made with other species.
11. "Mating Modes and Female Choice in Short-Tailed Crickets *(Anurogryllus arboreus)*" by T.J. Walker — a gryllid widely distributed in the southeastern United States.

12. "Cockroach Mating Systems" by M.D. Breed — members of several families are discussed, mostly well-known synanthopic or laboratory species, but including a few others.
13. "The Mating System of *Trimerotropis maritima* (Acrididae: Oedipodinae)" by J.B. Steinberg and R.B. Willey — a widely distributed North American crepitating grasshopper.
14. "Mating Behavior of the Primitive Orthopteran Genus *Cyphoderris* (Haglidae)" by G.N. Dodson, G.K. Morris and D.T. Gwynne — the three species of this relict, western North American prophalangopsid genus are discussed. (The authorship indicated for the Asiatic *Prophalangopsis obcura*, mentioned in the introduction, incidentally, is erroneous.)
15. "The Adaptive Significance of Female Multiple Matings in House and Field Crickets" by S.K. Sakaluk and W.H. Cade — concerned mostly with the gryllids *Acheta domesticus* (commercially reared) and *Gryllus intiger* (from Texas).
16. "Male Nutritional Investment and the Evolution of Sexual Differences in Tettigoniidae and other Orthoptera" by D.T. Gwynne — a general review covering Grylloidea and Acridoidea as well as Tettigonioidea (including some Tettigoniidae, *s. str.*).

As stated on the flyleaf of the book, the publication of the papers read at the symposium presents "for the first time a comprehensive study of the diverse mating ecology of a large group of insects" (the orthopteroid orders) in one volume. It is therefore to be strongly commended. As in all symposium publications, the quality of the individual contributions varies, but, in general, the standard is uniformly high. With its very heavy bias towards the Order Grylloptera (Orthoptera-Caelifera, *auctt.*), the book falls far short of what its title promises, but there is no doubt of its value to students of that group. The contributions should be of considerable interest to behaviourists, physiologists and ecologists in general, as well as to those more particularly concerned with orthopteroid insects.

Produced by photo-offset from a uniform typescript, the book is easy to handle and to read. The illustrations are clear and typographical errors seem to be minimal. That there are both systematic and subject-author indices is also gratifying. The volume deserves a place in any biological library.

D.K. McE. Kevan
Lyman Entomological Museum
and Research Laboratory
Macdonald College
McGill University

Leonhardt, B.A. and M. Beroza, Editors. 1982. *Insect Pheromone Technology: Chemistry and Applications*. American Chemical Society Symposium Series No. 190, M.J. Comstock, series editor. 260 pp. Hard cover. $ U.S. 35.95.

This volume is a selection of fourteen papers presented at a symposium sponsored by the Division of Pesticide Chemistry at the 182nd meeting of the American Chemical Society, New York, New York, August 25-26, 1981. The papers are arranged to cover three general aspects of pheromone research; isolation, identification, and syntheses; formulations for monitoring and control programs; and the utilization of pheromones in pest management programs.

The first paper describes methods of recovering pheromones from lepidopterous species and their analyses by high resolution capillary gas chromatography using liquid phases with widely different properties. The importance of studying the pheromone-mediated behavior of the moths is discussed. These are important aspects of any pheromone analyses.

The next four papers involve syntheses of unsaturated and chiral sex and aggregation pheromones. Several reactions are described that are most suitably done on a kilogram scale to give high yields of products with sufficiently high stereochemical purity for use in commercial applications. A brief review of asymmetric syntheses as related to pheromones and analyses of some chiral pheromones are presented. These papers are easily read as numerous structural diagrams and reaction schemes are included. A summary of some initial pheromone research on the muskrat is included in the fifth paper.

Papers six to nine deal with three types of pheromone dispensers, microencapsulation, hollow fibres, and laminates. These have been developed as a means of formulating synthetic

pheromones for use in monitoring and population suppression by mating disruption. The stability and dissipation rates of pheromones of different functionality and molecular weights from the three types of formulations are presented. Equipment designed for applying laminate formulations by aircraft and the use of stickers to hold the formulation onto plant material are described. Encouraging results are presented using these formulations for mating disruption or monitoring programs with the following species: pink bollworm, Egyptian cotton leafworm, corn earworm, tobacco budworm, artichoke plume moth, gypsy moth, western pine shoot borer, spruce budworm, peachtree borer, Comstock mealybug, citrus mealybug, and California red scale.

The distribution and persistence of pheromones from the three types of formulations in forests and in corn fields are discussed in papers ten and eleven. This includes the release rates of pheromones from aerial and point source applications of the formulations.

The last three papers summarize attempts to manage pest species by the utilization of pheromones. These include an initial mass trapping control program of the spruce bark beetle in Norway, control by mating disruption for the gypsy moth and western pine shoot borer, and monitoring for the Douglas-fir tussock moth. In general these management programs were most effective in light infestations.

This volume provides a brief summary of the tremendous effort that has been directed toward pheromone identifications, syntheses, and formulations for monitoring and control of insects. It also points out several needs for further research on pheromone applications such as methods for analyzing pheromone concentrations in the air under field conditions, for more efficient insect trap designs and for the continuation of mating disruption and monitoring projects. There is obviously a need for more interdisciplinary research on the utilization of pheromones and for long-term research planning with appropriate financial support if the ultimate value of pheromones in pest management is to be realized. The volume is a useful reference for those interested in the utilization of pheromones as an alternative to insecticides for pest management.

Dean L. Struble
Agriculture Canada Research Station
Lethbridge, Alberta

Metcalf, R.L. and W.H. Luckmann, Editors. 1982. *Introduction to Insect Pest Management.* Second Edition. John Wiley and Sons. xiv + 577 pp. Hard cover. $ U.S. 32.50.

Text books on economic entomology usually approach their topic in one of two ways. Either they catalogue insect pests and indicate how each is controlled, or they deal with different methods of control and may include examples for specific insect pests. Both approaches have disadvantages. The first leaves the student overwhelmed with information but ignorant of the general principles of control. The second provides the principles, but specific examples are often considered in isolation; the student does not know how the example fits into the framework of pest control and cultural practice for the commodity protected. The format of Metcalf and Luckmann's book avoids these pitfalls: there are three chapters of introductory and background material, seven chapters on the principles and methods of pest management, and five chapters exemplifying pest management in various agricultural systems.

The book is a multi-authored text aimed, so the dust cover states, at "students and field workers involved in entomology, forestry, or vector biology". However, the book concentrates on crop protection, there is one chapter on vector biology, and only a few scattered items on forest insects. We are told that this, the second edition, was completely revised and updated to reflect advances in pest management. The updating has failed to keep pace with the advances. The first edition was extremely up-to-date, 402 references (over 50%) were from the seven year period immediately before its publication; the second edition followed its predecessor by seven years, but only 205 references (22%) come from this intervening period. Some typographic errors of the first edition are faithfully reproduced in the second. The major differences from the first edition are the inclusion of an appendix on insecticides and acaricides and the substitution of a chapter on pest management of corn insects for one on forest insect management.

Following an introductory chapter by the editors, comes "Ecological Aspects of Pest Management" by P.W. Price and G.P. Waldbauer. This is almost entirely community ecology: mainly diversity and stability, and the colonization of crop islands. Since pest management involves manipulating populations and predicting phenological events, I would like to see a

rigorous treatment of insect population dynamics in this chapter, and some information on physiological ecology. The current contents do not seeem particularly relevant to the rest of the book, and are presented uncritically. For example, Southwood's data on herbivores on trees (J. Anim. Ecol. (1961) *30*, 1-8) are used to support the assertion that the number of herbivore species/plant increases with evolutionary time. The several dissenting reanalyses of the data (H.J.B. Birks (1980) Amer. Nat. *115*, 600-5) are not mentioned.

J.C. Headley's chapter "The economics of pest management" is a disappointment. Pest management programs have economic consequences and are carried out for or by farmers whose motive is profit, so it is appropriate that economic entomologists know something about economics. However, this chapter will surely reinforce the view among entomologists that economics is difficult or irrelevant. Economic injury levels are disposed of in a few lines, and from thereon the territory is unfamiliar. Headley explores the properties of a system where the inputs to pest control can be varied; but does so with the aid of a figure, half of which would be much better inverted. The next obstacle is an example of a two-period pest control system in which the symbols for different control options change midway through the explanation. The chapter makes some useful points, but with these obstacles how many will read them?

The next three chapters are on host plant resistance (M. Kogan), biological control with parasitoids and predators (F. Stehr) and the use of insect pathogens (J.V. Maddox), and they are all well written and reasonably up-to-date. R.L. Metcalf's chapter "Insecticides in Pest Management" deals with the advantages and disadvantages of insecticides, resistance, and methods of use which result in selectivity. This is excellent as far as it goes, but insecticides are the most powerful and most frequently used methods of control, and I think that a text on pest management should tell students what they are and how they work. The appendix to this chapter lists the formulae, toxicities, modes of action and environmental properties of common insecticides and acaricides, but it is unlikely that students can assimilate the properties of the 65 listed compounds in any useful way. What is needed is a description of the characteristic properties of insecticide groups and information on common formulations and application techniques.

Attractants, repellents, and genetic control are treated next (by R.L. Metcalf and R.A. Metcalf). In view of their importance in pest management, the treatment of pheromones seems disproportionately short; one omission is a discussion of factors affecting pheromone trap catches.

The chapter on sampling methods (W.G. Ruesink and M. Kogan) seems unbalanced. It is impossible to deal in a single chapter with all the sampling methods used, so why is space devoted to techniques seldom used in insect pest management? Nearest neighbour techniques, removal trapping and mark recapture methods seem out of place here. The chapter on modelling (by W.G. Ruesink) is straightforward, though I find it strange that the section on life tables appears after that dealing with models using the life table approach.

The chapter by H.T. Reynolds, P.L. Adkisson, R.F. Smith and R.E. Frisbie is a good review of the complex pest system and pest management of cotton. It does seem unfortunate that mention of boll weevil eradication was avoided. There are valuable lessons for pest managers even in this controversial issue. The chapter on forage crops insect pest management (by E.J. Armbrust and G.G. Gyrisco) deals almost exclusively with alfalfa weevil. It is therefore innapropriate to illustrate the chapter with the pest complex of a red clover plant. The illustration of the life cycle of the alfalfa weevil is confusing and the accompanying text unhelpful. Much of this chapter is verbose, and there is little evidence of updating from the first edition. In contrast B.A. Croft's chapter on apple pest management is thoroughly revised, well organized and well-written. W.H. Luckmann's chapter on corn insect management is new in this edition and a good up-to-date review of its topic.

The text of R.L. Metcalf's chapter on pest-management strategies for insects affecting man and domestic animals is adequate, but it is divorced from some of the illustrative material: without adequate supporting text the figure showing water-level management for mosquito control, and the table showing results of control options for trachoma are meaningless.

As with many multi-author texts, the quality of this book is variable. The minimal revisions done by some authors result in the second edition overall being less up-to-date than the first edition was in 1975. The text is still a valuable source book, and anyone seriously interested in insect pest management should have a copy. However, owners of the first edition may not need to buy the second.

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Mittler, T.E. and R.H. Dadd, Editors. 1983. *Metabolic Aspects of Lipid Nutrition in Insects.* Westview Press, Boulder, Colorado. x + 252 pp. Hard cover. $ U.S. 27.50.

Lipids serve several important physiological roles in insect biology. They are essential structural components of cellular membranes, provide a major source of metabolic energy for periods of prolonged energy demand (e.g. diapause, migration), facilitate water conservation by the formation of an impermeable cuticular barrier and by yielding metabolic water upon oxidation; in addition, many lipid molecules function as hormones, pheromones or other regulatory factors. Thus, it is not surprising that the study of insect lipids should have attracted the attention of many entomologists. The considerable current interest in insect lipids was acknowledged by a symposium on "Metabolic Aspects of Lipid Nutrition in Insects" which formed part of the scientific programme of the International Congress of Entomology held in Kyoto, Japan in 1980. The present volume presents an updated version of that symposium together with additional contributions that were solicited to provide a more complete coverage of the topic than was possible in the original symposium.

The author of a review on any aspect of entomology must cope with the enormous diversity of the class Insecta. This diversity is expressed in biochemical processes as readily as in other aspects of insect biology and cautions against generalizations that are based on observations of one, or even a few, species. For this reason, it is important that any volume which purports to deal with the Class Insecta should include, whenever possible, cogent assimilations of results obtained from a variety of species. Unfortunately, this has not been achieved for every topic addressed by the present volume. For example, the role of lipids in growth and reproduction is restricted to a single chapter by J.E. McFarlane, concerned principally with studies on vitamins E and K_1 in the cricket; thus, the extensive literature on this important topic is neglected. The subject of digestion and absorption of lipids is covered in a single chapter by S. Turunen which concentrates on the absorption of fatty acids across the gut of lepidopterous larvae; only cursory attention is given to other species and the absorption of sterols is ignored. Although McFarlane and Turunen deal with their specific topics in a competent manner, the inclusion of additional chapters to permit more complete treatment of these areas would have enhanced the volume considerably.

In spite of the shortcomings indicated above, there are many positive features which commend the volume to research scientists and students of insect physiology/biochemistry. In the first chapter, J.A. Svoboda and M.J. Thompson emphasize the diverse nature of biochemical processes by detailing variations in sterol metabolism within eight insect species and, in the second chapter, M. Morisaki and his associates discuss sterol metabolism in another species, *Bombyx mori*. The contributions of symbiotes to the lipid metabolism of insects is compellingly demonstrated by chapters on "Lipid interdependencies between *Xyleborus* Ambrosia beetles and their ectosymbiotic microbes" by K.D.P. Rao, D.M. Norris and H.M. Chu and "Sterol biosynthesis by symbiotes of aphids and leafhoppers" by H. Noda and T.E. Mittler; although an assimilative overview of the contributions of symbiotes to the lipid metabolism of insects in general would have been a welcome addition. It should be noted also that the reproduction of photomicrographs in the two chapters on symbiotes could have been improved. The metabolic determination and regulation of fatty acid composition in parasitic Hymenoptera is admirably discussed by S.N. Thompson and J.S. Barlow who provide a comprehensive review of the subject and a useful update on recent studies of fatty acid biosynthesis. The chapter by R.H. Dadd on essential fatty acids is also excellent. It offers a lucid and intelligent discussion of the conflicting literature on requirements and synthesis of polyunsaturated fatty acids by insects and a valuable account of current (at least at the time of publication) knowledge of insect prostaglandins. R.G. Bridges provides a thorough and discriminating account of the structure, composition and metabolism of phospholipids in insect tissues. The transport of diacylglycerols within haemolymph is rigorously discussed by D.J. Van der Horst; however, the transport of sterols, phospholipids and hydrocarbons is not considered. The increasing sophistication of the techniques available to insect biochemists is ably demonstrated in the chapter by G.J. Blomquist and M. de Renobales. These authors describe the use of ^{13}C-NMR spectroscopy in elucidating the mechanism of cuticular hydrocarbon synthesis. The final chapter by J.L. Vaughn and S.J. Loulourdes discusses lipid nutrition and metabolism of insect cells in culture and, thereby, provides valuable resource material for a rapidly burgeoning field of investigation.

References are listed at the end of each chapter and are, in most cases, complete and current. The few typographical errors are not distracting, although readers using the volume to compile or update their own reference lists, should be aware of some spelling errors (e.g. p. 78, change G. Bloomquist to G.J. Blomquist; p. 166, change Katayiri to Katagiri). The index is comprehensive and accurate.

It should be apparent from the above account that the volume contains sufficient valuable information to warrant inclusion on the bookshelves of those researchers interested in insect lipid biochemistry. Indeed, with the inclusion of only a few more chapters, the title of the volume could have been broadened to embrace the entire area of insect lipid biochemistry. The editors, should be encouraged to consider such an expansion in any future editions.

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Raabe, M. 1982. *Insect Neurohormones*. Plenum Press, New York and London. xiv + 352 pp. Hard Cover. $ U.S. 42.50

Insect Neurohormones contains ten chapters and an Addendum. The chapters are: 1. Synthesis, Storage and Release of Neurohormones; 2. Control of Endocrin and Gland Activity; 3. Diapause; 4. Reproduction; 5. Functioning of the Visceral Muscles; 6. Morphological and Physiological Color Change; 7. Behavior and Rhythmic Phenomena; 8. Osmoregulation; 9. Metabolism; 10. Neurohormones and Cuticle. The Addendum is in the style of the addendum found in the last of Wiggleworth's *Principle of Insect Physiology* and consists of lists of statements gleaned no doubt from the literature at the last minute before going to press. The Addendum is an unsatisfactory attempt to be up to date but, I suppose, better than nothing.

There are many worthwhile features in *Insect Neurohormones*, the most valuable being detailed comparisons of insect and vertebrate neurohormone systems. Teachers of insect physiology will likely welcome these comparisons. At times the comparisons go too far or are a little farfetched, but nevertheless they raise many interesting points for discussion.

A second worthy feature of the book is the exhaustively complete bibliography of the European literature. For example, there are 25 citations of the physiologist Gersch, whose work is seldom cited by North American researchers.

The most serious shortcoming of the book is its hugely uncritical nature. Everything in the literature is cited, and everything published seems to be given equal weight, equal space and equal credence. The absence of a critical eye often leads Raabe into serious error. For example, in discussing the mode of action of tanning hormones, bursicon is said to increase the permeability of hemocytes to tyrosine. A careful reading of the relevant literature reveals that in fact none of the experiments needed to show an increase in hemocyte permeability to tyrosine in response to bursicon has ever been done! The statement is entirely speculative, and its acceptance and transmittal by an uncritical author as fact serves only to weaken an already weak discipline of insect physiology.

I note also that Raabe tends to recite the literature (almost a litany at times) rather than interpret and synthesize it. Perhaps in this age of the "information explosion" it is asking too much of an individual to synthesize the knowledge even in a field as specialized as insect neuroendocrinology.

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Book Notices

Chapman, R.F. 1982. *The Insects: Structure and Function*. 3rd Edition. Harvard University Press, Cambridge, Massachusetts. $ U.S. 35.00.

The third edition of this textbook is the result of a major revision and updating of the earlier, 1971, edition. The total increase in size of the volume amounts to 100 pages, about three-quarters of which is actual increase in text or text figures. This amounts to an average increase of two pages per chapter. The number of figures has risen from 509 to 582, an increase of 73, or 2-3 figures per chapter. However, since a significant number of older figures have been eliminated the amount of new material is somewhat greater than this.

New material is not distributed uniformly over all 35 chapters. Major areas of expansion and updating include the chapters, Feeding, Fat Body and General Metabolism, Locomotion, Movement and Control of Wings, Muscles, Flight Activity, Metamorphosis, Excretion and Salt and Water Regulation, Nervous System, Mechanoreception, Chemoreception, Circulatory System, Endocrine Organs and Hormones, and especially the chapter on Pheromones which has been expanded in the new edition to Exocrine Glands, Pheromones, and Defensive Secretions. The only major reduction appears to be the loss of the chapter on Diapause.

The only significant change in format is the movement of references from a single listing at the end of the text to individual listings at the end of each chapter.

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Matthews, J.R. and R.W. Matthews, Editors. 1982. *Insect Behavior: A Sourcebook of Laboratory and Field Exercises*. Westview Press, Boulder, Colorado. 324 pp. $ U.S. 20.00.

Twenty-five insect behaviorists contributed a total of 34 field and laboratory exercises to this volume which is appropriate to undergraduate university or advanced secondary school courses in behavior, biology, entomology, or invertebrate zoology. The exercises are classified into 10 categories: Observation, description, and analysis of behavior; spatial orientation; food location; food recognition and regulation; communication; defense; sexual behavior; brood care, nesting, and social life; integration and organization of behavior; and non-traditional behavioral study methods. A short section on common nonparametric statistical tests and statistical tables, and a useful index are included. As well as detailed instructions and lists of necessary materials in each exercise, a separate section called "aids to the instructor" gives additional hints on materials, questions, answers, and techniques.

The stimulation quotient varies among the exercises. Some make one want to set up the experiments immediately to find out what the answers are or what the insects do. Others emphasize the art of observation and hypothesis formation.

The book will be useful to those teaching behavior or field courses both as a source of exercises and as a stimulus for the development of similar exercises with different insects or different conditions. While the exercises have undoubtedly been well tested by the authors, only natural selection will determine which can be used in any particular area or for which facilities will be readily available. Just reading the book made me wish I had more time for insect behavior in my course. But a warning — the shading has been left off of the circular nippybugs so don't let this frustrate you.

Judith H. Myers
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Young, A.M. 1982. *Population Biology of Tropical Insects*. Plenum Press, New York. xiii + 511 pp. $ U.S. 57.50.

For "population biology" in the title of this book, I would substitute "ecology". There are three chapters on population responses to various aspects of tropical environments and another on insect distribution patterns. The remaining six chapters deal with topics such as physiological and behavioural responses of tropical insects, insect-plant interactions, tropical insect communities, insects of agricultural habitats in the tropics, and biogeography of tropical insect faunas.

The emphasis is on neotropical forest systems; deserts and savannas receive scant attention, and aquatic insects of the tropics none at all. The bibliography contains almost 800 references and is one of the books greatest strengths; however the book seems poorly organized and, in some chapters, inadequately illustrated.

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New Books and Publications

Ant-Plant Interactions in Australia. R.C. Buckley, Ed. Junk, The Hague (U.S. distributor: Kluwer, Boston, Hingham, Massachusetts), 1982. 162 pp. $ U.S. 54.50.

Biting Flies in Canada. Health Effects and Economic Consequences. M. Laird and 12 others. NRCC No. 19248, National Research Council, Ottawa. 158 pp. $5.00.

Microbial and Viral Presticides. E. Kurstak, Ed. Dekker, N.Y., 1982. 720 pp. $ U.S. 99.50.

Pesticide Residues and Exposure. J.R. Plimmer, Ed. American Chemical Society Symposium Series No. 182. American Chemical Society, Washington, D.C., 1982. 214 pp. $ U.S. 27.95.

Plant Resistance to Insects. P.A. Hedin, Ed. American Chemical Society Symposium Series No. 208. American Chemical Society, Washington, D.C., 1983. 376 pp. $ U.S. 44.95.

Surface Structure of Insect. Pursuit of Fine Structure through *Bombyx* Life Cycle. H. Akai. Japanese Scientific Societies Press, Tokyo. 1982. (Distributor: Business Centre for Academic Societies Japan, Tokyo). 150 pp. $ U.S. 40.00.

The Ultrastructure and Functioning of Insect Cells. Proceedings of the International Conference, Sapporo, Japan, August 3-6, 1982. H. Akai, R.C. King and S. Morohoshi, Eds. Society for Insect Cells Japan, Tokyo, 1982. (Distributor: Business Center for Academic Societies Japan, Tokyo). 208 pp. $ U.S. 28.00.

Update on Publications

Republication of Frederick Valentine Melsheimer's 1806 *"A Catalogue of Insects of Pennsylvania"*, the first separate work devoted to American insects. The facsimile lists more than 1,300 species of Coleoptera (other orders were not completed), and includes a short biography of Melsheimer. $ U.S. 5.00 (overseas, airmail $ U.S. 6.50), payable to Entomological Society of Pennsylvania, c/o Entomology Department, Pennsylvania State University, University Park, PA 16802, U.S.A.

The *Arthropods of Canadian Grasslands Newsletter* is intended as a forum for communication among those sharing an interest in this fauna. It will be produced as least once a year. The first issue is available and provides information about three grassland sites which entomologists are encouraged to study. Forthcoming issues will list investigators and projects underway. Contact: Dr. John Spence, Editor, Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3.

The *Trichoptera Newsletter* was established in 1975 as one result of the First International Symposium on Trichoptera held in Lunz, Austria. Under its founding editor, Dr. Hans Malicky (Biologische Station Lunz der Osterr. Akademie der Wissenschaften, A-3293 Lunz am See, Austria), issue #9 appeared in August 1982. The Newsletter promotes interchange of information among research workers concerned with Trichoptera, and these items are invited by the editor; a bibliography of current published papers dealing with Trichoptera is also maintained. It is not intended as a medium of publication for results of research. The Newsletter is available at no cost to those with a serious interest in Trichoptera; the last mailing comprised some 500 copies to 42 countries. To assist with the cost of production and mailing, distributors have been designated for particular areas; Dr. Glenn B. Wiggins (Department of Entomology, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6) is responsible for the mailing to recipients in Canada.

The following Memoirs of the Lyman Entomological Museum are available from the Secretary of the Museum, Macdonald College, McGill University, Ste. Anne de Bellevue, P.Q. H9X 1C0:

No. 10 *The Land of the Locusts, Being Further Verses on Grigs: Part II (between 450 and 1,500 A.D.)*. D.K. McE. Kevan. 1983 vii + 554 pp. $29.00.

No. 11: *The Sphecoidea of Southern Quebec (Hymenoptera)*. A.T. Finnamore. 1982. ix + 348 pp., 144 illustrations. $17.00.

No. 12: *Revision of the American Species of Mimesa (Hymenoptera: Pemphredonidae: Pseninae)*. A.T. Finnamore. 1983. vi + 171 pp., 365 illustrations. $15.50.

The following Memoirs of the Lyman Entomological Museum are in preparation:

No. 13: *A Monograph of the Orthopteroid Insects of Canada and Adjacent Regions*. V.R. Vickery and D.K. McE. Kevan. xxii + 1462 pp., 7 coloured plates, 6 black and white plates, 824 illustrations, 237 maps.

No. 14: *Revision Checklist of the Butterflies and Skippers of Canada*. W.W. Gregory. Replaces Memoir 3, 1975.

ENTOMOLOGICAL SOCIETY OF CANADA
Publications Available for Sale

Arctic Arthropods. A review of systematics and ecology with particular reference to the North American fauna. H.V. Danks. 1981. Hard covers, 608 pp. A comprehensive overview of the arctic arthropods including information on physiography, climates, soils, and plants and animals of the arctic lands. Nearly 2,500 references. A valuable reference.

Bibliography of arctic arthropods of the nearctic region. Compiled by H.V. Danks. 1981. Soft covers, 125 pp. A useful supplement to the Arctic Arthropods. About a third of the references not cited in above book.

Memoir 115: *The polyphetic nature of Apanteles Foerster (Hymenoptera: Braconidae): A phylogeny and reclassification of Microgastrinae.* W.R.M. Mason. 1981. 147 pp.

Mémoire 116: *Revision des Trichoptères canadiens. I. La famille des Rhyacophilidae (Annulipalpia).* F. Schmid. 1981. 83 pp.

Memoir 117: *Guide to the Geometridae of Canada (Lepidoptera). II. Subfamily Ennominae. 3.* W.C. McGuffin. 1981. 153 pp.

Memoir 118: *Taxonomic monograph of the genus Pityophthorus Eichhoff in North and Central America (Coleoptera: Scolytidae).* Donald E. Bright. 1981. 378 pp.

Memoir 119: *A revision of the genus Lordithon Thomson of North and Central America (Coleoptera: Staphylinidae).* J.M. Campbell. 1982. 116 pp.

Memoir 120: *Revision of the subfamily Xantholininae of America north of Mexico (Coleoptera: Staphylinidae).* Ales Smetana. 1982. 394 pp.

Mémoire 121: *La famille des Xiphocentronides (Trichoptera: Annulipalpia).* F. Schmid. 1982. 127 pp.

Mémoire 122: *Revision des Trichoptères canadiens. II. Les Glossosomatidae et Philopotamidae (Annulipalpia).* F. Schmid. 1982. 78 pp.

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POSITIONS AVAILABLE

Medical Entomologist/Parasitologist. Full-time, 11-month tenure-track appointment at assistant professor level beginning 1 September 1983. Research to emphasize ecology, feeding behavior, and vector relationships of ticks, mites, and related ectoparasites associated with zoonotic pathogens. Teaching involves shared responsibility for undergraduate and graduate courses in medical/veterinary entomology and parasitology. Qualifications include a Ph.D degree and evidence of outstanding potential for teaching and research. Application should include: (i) curriculum vitae, academic transcripts, and evidence of teaching skills and experience, (ii) bibliography and reprints of significant publications or manuscripts, (iii) a statement outlining research areas and approaches used, and (iv) names and addresses of at least three people who can provide recommendations. All materials should be submitted by 1 July 1983 to: E.S. Sylvester, Chair, Department of Entomological Sciences, 201 Wellman Hall, University of California, Berkeley, Calif. 94720.

Environmental Toxicologist. Applications are invited for a tenure-track position at the level of assistant professor. The successful applicant will participate in a programme in environmental toxicology at the undergraduate and graduate level. Candidates must have a Ph.D. degree with experience in toxicology and a strong record in research. The Successful applicant will be expected to develop and maintain an active research programme in an area of toxicology appropriate to a life sciences department. The position is available immediately. Salary commensurate with experience. The current salary base for the assistant professor rank is $25,807. Applications should include curriculum vitae, a brief statement of research interests and objectives, and selected reprints of published research. Applicants should request confidential assessments of their research and teaching ability from at least three referees to be forwarded directly to: Dr. K.K. Nair, Chairman, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6.

Deadline for receipt of applications is 30 June 1983, or until the position is filled.

Biological Sciences. Applications are invited for a full-time one-year position to replace a faculty member of sabbatical leave for 1983-84. Applicants must have a Ph.D. and preferably some teaching experience. The successful candidate will teach semester courses in metabolism, general physiology, plus an additional course in the area of expertise of the appointee. The appointment will be at the rank of Assistant Professor (Floor $27,235) (1981-82 scale; under revision). Please submit applications with curriculum vitae and names of three referees to: Dr. K.J. Kuepper, Dean of Faculty, Bishop's University, Lennoxville, Quebec J1M 1Z7.

Research Director; *to start entomology research division;* design and development of insect traps using insect behavior, trap aerodynamics, field tests; evaluation of semiochemicals; development of application guidelines. $18,000-$24,000 per annum plus vehicle or expense. Qualifications: M.P.M. and Ph.D. or field experience in forest entomology plus research with multiple funnel traps, mass trapping forest coleoptera or innovative design of insect traps. Required to work and travel as required for field evaluations or to provide technical assistance for marketing. Contact: M. Banfield, PMG/Stratford Projects Ltd., 545 West 8th Avenue, Vancouver, B.C. V5Z 1C6 (604) 876-1446.

Specialist in Entomology. To work with a team of entomologists and forage-livestock scientists developing *management tactics for pasture systems to regulate spittelbug densities.* Ph.D. in applied biology and evidence of good publishing record. Experience in pasture-forage, rangeland entomology, habitat manipulation, biological control, systems analysis, and fluency in Portuguese or Spanish, preferred, not required. Send curriculum vitae, transcripts, list of publications, 3 letters of recommendation, to M.A. Naves, Coordinator of Spittlebug Project, EM-BRAPA, Ed. Venancio 2000, sala 916, 70.333-Brasilia-DF, Brasil.

The National University of Singapore plans to expand its academic staff by 1985-86. Applications are invited for appointments in the *Faculty of Science (Botany, Chemistry, Physics, Zoology, Pharmacy).* Contact Mr. Peter Lim, Director, North America Office, National University of Singapore, 61 West 62nd Street, Suite 4J, New York, New York 10023, U.S.A., telephone (212) 765-1670, or The Director, Personnel Department, National University of Singapore, Kent Ridge, Singapore 0511, Republic of Singapore.

Specialist positions with the *Onchocerciasis Control Program* of WHO may be available. Persons who have training or experience with some aspect of biting fly, particularly blackfly, research or control, some elementary parasitology, familiarity with blackfly development and behavior, and an aptitude for field work under relatively rough conditions are encouraged to submit curriculum vitae to Dr. E.M. Samba, Director, Onchocerciasis Control Program, BP 549, Onagadougou, Haute Volta.

Graduate Research Assistantships

Half-time academic year, full time summer (3 months). Stipend $7,000-$8,000, dependent upon education and experience. Project on *pheromones of ticks*. Experience in TLC, chromatography, physiology or biochemistry desirable. Opportunities for Ph.D. of M.S. level graduate study in ecology or biomedical sciences. Qualified applicants waive out of state tuition. Send resume, transcripts, three letters of reference, to Dr. D.E. Sonenshine, Department of Biological Sciences, Old Dominion University, Norfolk, VA 23508 (804) 440-3612 or 3595.

The *behavior and ecology of insects in urban gardens and yards* are being studied at Georgetown University. Present studies include the reproductive and foraging behavior of the carpenter bee, *Xylocopa virginica*; parasitization and reproductive behavior of the chalcidoid wasp, *Pediobius foveolatus*, which attacks the Mexican barn beetle; the behavior of bagworm caterpillars; the pollination behavior of butterflies; syrphid fly communities; and whiteflies on tomatoes. If you are a qualified student who would like to work toward an M.S. or Ph.D. in the behavior and ecology of insects at Georgetown University, contact Professor Edward M. Barrows, Department of Biology, Gerogetown University, Washington, D.C. 20057. Fellowships are available on a competitive basis to students who are accepted for the Ph.D. program.

Two Assistantships available immediately. Research towards M.S. in *insect pest management*. Stipend $4,500/year plus tuition waiver. Admission to graduate school required. Contact Dr. C.J. Southards, Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, Tennessee, U.S.A.

POSITIONS SOUGHT

Self-employed, Canadian *Insect Taxonomist*, trained in Canada, with 14 years experience in Insect Systematics and five years Post-doctoral experience in Mosquito Biology, Resource Management and Palaeolimnology desires contract work to identify insects. Contact: Peter Arntfield, Ph.D., 225 Laurent Drive, Winnipeg, Manitoba, R3V 1S1. Telephone (204) 269-9858.

OBITUARY

Walter Edward Whitehead 1891 - 1982

Walter E. Whitehead, former professor of entomology at Macdonald College, McGill University, died in late December, 1982, aged 91 years.

Mr. Whitehead was born in Harrow, England on June 29, 1891. He was employed by the province of Nova Scotia for a number of years as assistant in entomology, where he worked mainly for Dr. W.H. Brittain. Dr. Brittain came to Mcdonald College in 1925 and Whitehead followed him in 1926. Mr. Whitehead obtained the B.S.A. degree in 1930 and the M.Sc. in 1931, in entomology, both from McGill University. Promotion was slow in those days but he was made Assistant Professor in 1948.

Many Mcdonald graduates remember Mr. Whitehead as a kindly gentleman who was exacting in his requirements from students. His own work was meticulous and he expected all students to do their best. A mere passing grade was never good enough. He wrote a number of scientific papers and is remembered especially for his talents as artist, illustrator and photo-

grapher. His illustrations appear in numerous papers of other authors, especially those of W.H. Brittain. (The Lyman Entomological Museum and Research Laboratory has preserved a number of his original illustrations).

McGill University benefitted from his artistic talents. For many years he lettered the university degrees and diplomas in fine old-English script. The Macdonald books of remembrance of World Wars I & II were also his work. As well, he lettered the McGill "Book of Remembrance", including the title page and the coat of arms.

Mr. Whitehead retired in 1956 and established his home in Round Hill, Annapolis County, Nova Scotia. Gardening was a favourite hobby and he delighted in raising prize roses. He was active in community affairs, especially those with horticultural aspects. Possibly his last entomological effort was the designing of the crest for the Acadian Entomological Society.

Although his health declined in his later years, he remained active and still displayed much of his earlier activity and enthusiasm when I last saw him at his home in August, 1982.

Mr. & Mrs. Whitehead were married in October, 1917, and enjoyed 65 years of happy marriage. Mrs. Whitehead, whose health is rather poor, continues to live in their Nova Scotian home.

V.R. Vickery
Lyman Entomological Museum and
Research Laboratory
Macdonald College
McGill University

RECENT DEATHS

Stanton D. Hicks. On 9 April 1983. Age 73. Retired, Biosystematics Research Institute, Agriculture Canada. Former member ESC, ESO.

George Stirrett. Grand Falls, N.B. On 15 December 1982. Age 83. Formerly head of Agriculture Canada laboratory at Chatham, Ontario, the chief naturalist for Parks Canada.

Jean-Baptiste Maltais. Chambly, Québec. On 10 September 1982. Retired (1963) research scientist Agriculture Canada, St-Jean, Québec.

EDITOR'S REMARKS

With the theme of the 1983 Joint Meeting of the Entomological Society of Canada and Entomological Society of Saskatchewan being "Integrated Pest Management", it is particularly appropriate that Freeman McEwen chose to address this subject in our Guest Editorial. Hopefully, Regina will provide the setting for an unfolding of some of the "new tools" and development of the "new wisdom" that he recognised as being needed.

The "Call for Papers" for the Joint Meeting was published in the March 1983 Bulletin. Everyone who wishes to participate in submitted paper and poster presentations is urged to send the reply form (page 21) to Mr. M.G. Maw, Program Chairman, Agriculture Canada Research Station, Regina, as soon as possible.

This is the third issue of the Bulletin which is being produced by phototypesetting, rather than from camera-ready copy. The Governing Board, at its meetings in Toronto, approved a trial period of one year, i.e. four issues, in which the Editor was to use typesetting, after which the process was to be evaluated. So far, I have received several letters, all of them expressing approval of the new format, and I would welcome hearing the views of any reader who feels strongly one way or the other.

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Remarques de la Rédactrice

Le thème de la réunion collective de la Société des Entomologistes du Canada et de la Société des Entomologistes du Saskatchewan en 1983 est "L'administration Intégrale des Insectes". C'est donc, très à propos, que Freeman McEwen s'est addressé à ce sujet dans notre éditorial invité. On espère que c'est à Régina qu'on découvra quelques-uns de ces "nouveaux outils" et qu'on développera cette "nouvelle sagesse" dont nous avons besoin selon McEwen.

"L'invite des papiers" pour la réunion collective a été publié au Bulletin de mars 1983. Chacun qui veut lire un papier ou présenter une affiche illustrée doit remplir et envoyer la formule de réponse (à la page 21) à Mr. M.G. Maw, Program Chairman, Agriculture Canada Research Station, Régina, aussitôt que possible.

Ceci est le troisième numéro du Bulletin qu'on a produit par la photocomposition au lieu d'employer une "appareil-prêt" copie. Le conseil d'administration, à ses réunions à Toronto, a approuvé une période d'essai d'une année, c'est-à-dire, quatre numéros, dans laquelle la rédactrice employerait la photocomposition. Ensuite le conseil évaluerait le processus. Jusqu'à maintenant, j'ai reçu plusieurs lettres dont toutes approuvaient le nouveau format. Je tiens beaucoup à entendre l'avis d'aucun lecteur qui y attache une grande importance.

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ENTOMOLOGICAL EDUCATION IN CANADIAN UNIVERSITIES DURING THE 1981-82 ACADEMIC YEAR

Prepared by

The Study Group on Entomology Curricula of the Science Policy Committee Entomological Society of Canada

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February, 1983

INTRODUCTION

The Science Policy Committee of the Entomological Society of Canada requested that a study be undertaken of the entomology curricula of Canadian Universities. The committee felt that it is appropriate that a national entomological society should be aware of the nature and extent of training in entomology, within Canada. Such awareness might reveal deficiencies in the overall pattern of Canadian entomological training which, if not corrected, could damage the future development of entomology in Canada.

The report is concerned with Bachelor's, Master's and Doctoral levels of study. Formal courses and supervised research both have a part in producing individuals with appropriate qualifications for those degrees, with emphasis on courses at the Bachelor's level, and on research at the two graduate levels.

Data on entomology courses and on graduate students undertaking research in entomological fields were collected and examined. These data provide a comprehensive picture of entomological education in Canada and, as such, are of value to the Entomological Society of Canada and to educators and administrators in entomological education. In addition students planning their education may find these data useful. Entry into graduate programs in entomology is either by way of undergraduate specialization in this field, or by a more general science degree, from either faculties of agriculture, or of arts and science.

DEFINITIONS AND CLASSIFICATION

Before data collection could begin it was necessary to establish definitions to ensure uniformity of treatment of data. The following were used:

Entomology: Study of insects and terrestrial arthropods including their control.

Institution: Graduate data are classified by institution. An institution may include a number of campuses and departments.

Campus: A single campus of a university is the unit used in the undergraduate course data. A campus may contain more than one department offering courses in entomology, no distinction is made between such departments.

Course with significant entomological content: A course where more than 30% of the content was devoted to entomology.

Courses with significant entomological content were classified into either "Entomology courses", in which more than 50% was entomology, or others, where 30-50% of course content was entomology.

DATA COLLECTION

All university departments in Canada in which entomology courses might be offered or graduate students trained in entomology were identified using Royce (1980). Course offerings in each of the departments were examined in the appropriate university calendars. Where courses had significant entomological content, details from the calendar were entered on a form. The completed forms were then sent to the department concerned for verification and addition of information not available in the calendar. All departments where graduate students might be trained in entomology were requested to provide information on number of students enrolled in such programs on a standard form. In addition, some departments in which undergraduate specialization in entomology could occur were asked to complete a form detailing program structure. The data were gathered in Winter 1981-82.

COURSE UNITS

Course size were reported on forms as hours/week for a stated number of weeks. Because there is no uniformity regarding course length or number of contact hours/week, the study group converted all courses to a standard unit. The standard unit used (C.U.) represents about 30 hours of lecture time with or without a laboratory. Hence one C.U. represents a 13-week course of three 50-minute lectures/week. However, course lengths from 12 weeks to 15 weeks were also considered to be one C.U. This was done because the study group felt that the variation in course content between 12-week and 15-week courses was probably not large enough, compared with variation in content among courses of the same length, to justify the increased complexity caused by allotting different values to courses of different length.

UNDERGRADUATE COURSES

From university calendars, 47 campuses appeared to have courses with significant entomological content, 39 campuses provided information additional to that in the calendar.

There are 84 course units (C.U.) in Canada with 30-50% entomological content, and 155 C.U. with more than 50% entomological content, including 2 C.U. at Nova Scotia Agricultural College. A complete breakdown of these, by campus, was made. Six campuses (four of them in the Maritime Provinces) offer a single course with 30-50% entomological content; such courses are usually called invertebrate biology and are a component of a biology degree. Twelve other campuses offer a single C.U. with > 50% entomology; these courses are usually associated with one or more invertebrate biology courses in a biology degree program.

There are 29 campuses offering 2 or more C.U. of courses with > 50% entomology; among them they offer 55 C.U. 30-50% entomology and 139 C.U. > 50% entomology. About 45% of all undergraduate Canadian C.U.'s with significant entomological content are offered on eight campuses (Table 1). The course units shown in Table 1 cannot be readily translated into programs of study which students take. Nevertheless some patterns are evident. Alberta, Guelph and Manitoba offer major programs in entomology within Faculties of Agriculture; their course offerings include service courses to other Departments within the Faculties of Agriculture and of Science, but also a strong program in the study of insect biology and applied entomology for entomology students. Macdonald college follows a similar pattern but the major offered there is in zoological sciences. At the University of British Columbia and at Simon Fraser University the emphasis is on pest control; hence there are fewer courses on

Table 1. Field of knowledge covered by undergraduate courses with significant entomological content offered on eight campuses. Figures indicate number of course units in each field.

	Alberta	*B.C.*	*Carlton*	*Guelph*	*Manitoba*	*McGill Macdonald*	*Simon Fraser*	*Toronto St. George*
Introductory, General, Unspecified[1]	3	3	0	2	3	1	2	2
Anatomy, Physiology, Biochemistry[1]	3	1	2	2	2	3	0	2
Systematics, taxonomy, evolution[1]	1	0	2	1	1	1	0	2
Ecology, Aquatic entomology, Behaviour, Social insects[1]	0	0	2	5	4	1	0	2
Applied entomology:								
crops, stored products[1]	0	0	0	0	1	0	0	0
forestry[1]	2	2	0	1	0	0	0	0
medical, veterinary[1]	2	0	0	1	1	0	0	3
insect toxicology[1]	1	0	0	0	1	0	0	0
general[1]	3	1	0	3	1	3	1	0
Apiculture[1]	0	0	0	3	0	1	2	0
Terrestrial arthropods[1]	0	0	0	0	0	1	0	0
Invertebrate Biology[2]	1	0	2	0	2	3	2	1
Pest Control[2]	0	3	0	0	0	0	1	0
Pesticides[2]	0	1	0	2	0	0	1	0
Parasitology[2]	0	0	0	0	1	0	0	0

[1] Courses with > 50% entomology [2] 30-50% entomology

insect biology, and applied entomology is taught in agricultural systems — oriented pest control courses (e.g., "Crop protection — horticultural crops", which incorporates insect, weed and disease control). Carleton University and the St. George (Downtown) Campus of the University of Toronto offer courses in insect biology but, with the exception of Toronto's courses in arthropod-related disease, do not give courses in applied entomology.

Table 2 shows the C.U.'s offered in Canada broken down by region and field of knowledge. The C.U. distribution in British Columbia is greatly influenced by the two B.C. campuses in Table 1 which between them offer 20 of 26 C.U. Similarly, in the Prairies the Universities of Alberta and Manitoba account for 33 of the 52 C.U. In eastern Canada the contributions of C.U. units from campuses in Table 1 are relatively less important. In eastern Canada four campuses out of 38 offer more than 10 C.U. with significant entomological content; in western Canada there are also four campuses offering more than 10 C.U., but only nine campuses offer entomology courses. It has been suggested that entomology training is deficient in the maritime provinces (Turnock, 1980). There are nine campuses currently offering entomology courses in that region, and Nova Scotia Agricultural College plans to offer entomology courses from 1983. Until that time the only applied entomology course in the maritimes will be in forest entomology at the University of New Brunswick. Only four campuses in the Maritimes offer more than 2 C.U. with > 50% entomology.

In interpreting Table 2, it should be borne in mind that what is taught in insect ecology courses in one region may be taught in general entomology courses elsewhere; similarly crop protection entomology may be taught in general applied entomology courses. On a national scale there do appear to be some deficiencies. There are no undergraduate courses in insect pathology and only two in insect toxicology, despite their obvious importance in insect control. Terrestrial arthropods other than insects receive little attention except in Quebec.

Table 2. Regional distribution of undergraduate C.U. with > 50% entomology classified by field of knowledge.

	Maritimes	*Quebec*	*Ontario*	*Prairies*	*B.C.*	*Total*
Introductory, general, unspecified.	7	10	13	12	7	49
Anatomy, physiology, biochemistry.	1	5	8	5	1	20
Systematics, taxonomy, evolution.	2	4	6	3	0	15
Ecology, aquatic entomology, behaviour, social insects.	0	2	14	5	0	21
Applied entomology:						
crops, stored products	1	0	0	1	0	2
forestry	1	0	4	2	2	0
medical, veterinary	0	0	4	3	0	7
insect toxicology	0	0	0	2	0	2
general	0	6	5	5	3	19
Agriculture	0	1	3	0	2	6
Terrestrial arthropods	0	4	1	0	0	5
Total > 50% Entomology	12	32	58	38	15	155
Total 30-50% Entomology	11	8	40	14	11	84
Overall total	23	40	98	52	26	239
Number of campuses offering some entomology	10[1]	10	17	8	3	48[1]

[1] Includes Nova Scotia Agricultural College

Table 3 shows that most courses with > 50% entomology are taken in the last two years of the undergraduate program. (In Quebec the first year in the university was considered equivalent to second year elsewhere). The table also shows that the courses reported in Table 2 are normally available. Only five courses are offered so infrequently that they would not be available to all students.

Data on enrolment in courses were collected from all campuses where these data could be supplied. Data on enrolment in 115 C.U. with > 50% entomology were obtained. For these data the average enrolment/C.U. was about 20 students; however when data were adjusted to reflect frequency of offering the average number of students/C.U./year was 22. This indicates

Table 3. Frequency and time of offering of undergraduate C.U. with > 50% entomology.

	Regular Offerings		*Irregular Offerings*	*Total*
	Yrs 1-2	*Yrs. 3-4*		
Maritimes	—	11	1	12
Quebec	4	24	4	32
Ontario	1	57	—	58
Prairies	6	32	—	38
British Columbia	—	15	—	15
Total	11	139	5	155

that for the limited data base available there were 2,526 student C.U.'s of > 50% entomology in a year; if this is extrapolated to the 155 such C.U. in Canada the figure becomes 3,405 student/ C.U./yr. These figures should be treated with caution since a student taking more than one C.U./year in entomology would be represented more than once. Examination of 13 C.U. for the University of Manitoba shows that about 90% of the student C.U.'s are the result of students taking one C.U./year; these are mainly students majoring in other disciplines. Departments offering high enrolment courses for non entomologists would probably have a similar or higher percentage of students taking I C.U./year; however departments with few service courses could have most students taking 3-5 or more C.U./year in entomology. Because of these uncertainties it is not possible to determine total enrolment of students in entomology courses. However it seems likely that well over half the 3,405 student C.U.'s represent students having their only course in entomology.

UNDERGRADUATE PROGRAMS

The Universities of Alberta and Guelph, and Laval University were asked to supply details of the typical structure of a degree with major specialization in entomology. These programs are used to exemplify the different types of undergraduate programs with specialization in entomology. Table 4 shows that the entomology major program in Faculties of Agriculture emphasizes background science, humanities and arts courses in first year, one or two entomology and several agriculture courses in second year. In third and fourth years the programs are heavily laden with entomology, and while emphasis is on applied aspects, there is a thorough grounding in insect biology as well. The degree in the Faculty of Science at the University of Alberta has more emphasis on sciences in the first and second years than does the Agriculture degree; there is no humanities or arts component. There are a few more entomology courses in the science degree than in the agriculture degree, but many of the courses are the same in both degrees. Laval University offers a biology degree with specialization in entomology. The number of entomological courses in considerably less than in entomology degree programs. The Laval program has a more diverse entomological component than do many institutions offering degree programs in biology with entomological specialization.

GRADUATE COURSES

Data on graduate course offerings were collected in the same way as those for undergraduate courses. The C.U. system is also the same, though less satisfactory since many graduate courses are projects, or are of unspecified duration. Twenty-five institutions offer graduate courses in the field. Four universities (Acadia, Québec à Trois-Rivières, Ottawa and Western Ontario) have graduate students studying entomology, but no graduate courses in entomology. Three universities (Bishops, Regina and Windsor) offer graduate courses but currently have no graduate students working in entomology. Dalhousie and Moncton currently have neither graduate students nor graduate courses. The universities offering the most graduate C.U.'s with > 50% entomology are McGill, Manitoba, Alberta, Toronto, Simon Fraser, Laval, British Columbia, and Guelph. These eight offer about 68% of the graduate C.U.'s. It is noticeable that seven of the eight are also on the list of campuses offering most undergraduate C.U.'s: Carleton was on the undergraduate list but not on the graduate list. Laval did not appear on the undergraduate list.

Table 5 shows the regional breakdown of graduate C.U.'s. Again the paucity of entomology instruction in the maritimes is evident. Although of five campuses in this region which offer graduate training in entomology, only two offer any graduate courses in entomology. However, at the graduate level, absence of a course in a subject does not necessarily mean absence of training in the subject. For example there are five graduate students in British Columbia whose field of research is "systematics, taxonomy and evolution", but there are no graduate courses offered in that field of knowledge (Table 5).

There are unique features in many graduate entomology courses in Canada, and only a few can be mentioned. Simon Fraser University's Master of Pest Management program is the only one of its kind in Canada. The M.P.M. program is not an entomology program but students may specialize in insect pest management; 15 were reported to have done so in 1981-82. Only two courses were reported on plant disease vectors, these were at Simon

Table 4. Examples of undergraduate programs leading to degrees specialized in entomology.

University	Alberta		Guelph	Laval
Faculty	Agriculture	Science	Agriculture	Science & Engineering
Year 1	Science Courses Humanities Courses Arts Courses	Science Courses Language	Science Courses Humanities Courses Agriculture Courses	C.E.G.E.P.[1]
Year 2	General Entomology Agricultural Entomology Invertebrate Zoology Electives	General Entomology Forest Entomology Invertebrate Zoology Science Courses	Morphology of Insects Natural History of Insects Agriculture Courses Science Courses Humanities	Invertebrates Electives
Year 3	Forest Entomology	Insect Morphology	Pesticides in the Environment	Biotaxonomy of Insects
	Medical & Veterinary Ent. Insect Morphology Insect Toxicology Agriculture Electives	Medical & Veterinary Entomology Insect Ecology Project in Applied Entomology Science Courses	Introductory Agriculture Social Behaviour of Insects Invertebrate Zoology Agriculture and Science Courses	Insect Collection Forest Entomology Electives
Year 4	Insect Pest Management	Insect Development	Invertebrate Physiology	Morphology and Anatomy of Insects
	Insect Taxonomy Project in Applied Entomology Insect Development Agriculture Electives	Insect Taxonomy Insect Biology Insect Toxicology Project in Basic Entomology Insect Pest Management Insect Physiology Electives	Advanced Economic Entomology Insect Ecology Insect Biology Biological Control Forest Entomology Medical Entomology Agriculture Courses	Insect Pest Management Forest Entomology Electives Undergraduate Thesis

[1] C.E.G.E.P. is the acronym for Collège d'enseignement général et professionnel which students enter for two years following Grade 11.

Table 5. Regional distribution of graduate C.U.'s with > 50% entomology classified by field of knowledge.

	Maritimes	*Quebec*	*Ontario*	*Prairies*	*B.C.*	*Total*
General, unspecified	1	9	5	2	2	19
Anatomy, Physiology, Biochemistry	2	7	8	8	3	28
Systematics, Taxonomy, Evolution	0	6	7	4	0	17
Ecology, Aquatic Ent., Behaviour	0	7	5	7	2	21
Applied Entomology:						
Crops, stored products	0	2	0	1	2	5
Forestry	0	2	2	1	3	8
Medical, veterinary	0	1	1	1	0	3
Insect toxicology	0	0	0	3	1	4
General	1	1	2	3	4	11
Agriculture	0	2	1	0	0	3
Total > 50% entomology	4	37	31	30	17	119
30-50% entomology	2	4	7	3	5	21
Overall total	6	41	38	33	22	140

Fraser University (not in the M.P.M. program) and at the University of British Columbia. The University of Guelph offers a course on the classification and biology of immature insects; this seems to be unique in Canada. Macdonald College (McGill) offers two courses on soil fauna, including insects. The only course on stored products entomology is offered at the University of Manitoba. The University of New Brunswick offers a course on insect endrocrinology. Sherbrooke is the only university to offer courses each of which deals with a separate insect order: Hymenoptera, Coleoptera and Homoptera. It should be noted that there are four C.U.'s in Canada at the graduate level in insect toxicology, but there are no courses in insect pathology.

GRADUATE STUDENT ENROLMENT

All Universities at which graduate students might do research in entomology were asked to indicate the number, field of research, and source of their entomology students. Of the 33 universities contacted, 32 responded; there are no data from the University of Saskatchewan. Table 6 summarizes the area of research of graduate students. As of December 1981 there were 15 M.P.M. candidates, 171 M.Sc. candidates and 133 Ph.D. candidates specializing in entomology. In 1975 (McEwen *et al* 1976) the largest seven graduate schools were Simon Fraser, British Columbia, McGill, Guelph, Alberta, Manitoba and Toronto. All of the seven have increased graduate student enrolment in 1981 but there has been a larger increase in enrolment at Laval. The eight largest graduate schools in 1981-82 accommodated 67% of the students doing graduate work in entomology and are the same eight institutions which offer the most graduate C.U.'s in entomology.

Subject areas and institutions in which graduate students were concentrated were identified. (Table 7). Five or more graduate students per subject area per institution was used as a criterion for identification of concentration. Such concentration indicates in part special emphasis by institutions in certain subject areas, but other factors are probably involved as well in attracting students with particular predilections for specialization. It seems likely that a clumped pattern is normal, although size and location of clumps of specialists need not be constant over extended periods of time.

Table 6. Numbers of students enrolled in graduate degrees in entomological fields classified by field of research.

	M.Sc.[1]	*Ph.D*
Anatomy, Physiology, Biochemistry	37	25
Systematics, Taxonomy, Evolution	16	27
Ecology, Behaviour	58	50
Applied entomology: crops, stored products	30	17
Applied entomology: medical, veterinary	11	5
Applied entomology: forestry	19	5
Applied entomology: insect toxicology	9	1
Apiculture	5	1
Unknown	1	2
Total	186	133

[1] Includes 15 M.P.M. candidates.

Table 7. Concentration of five or more graduate students by institution and subject area, during the 1981-82 academic year.

	Anatomy, Physiology, Biochemistry	*Systematics, taxonomy, evolution*	*Ecology, behaviour*	*Applied entomology, crops, stored products*	*Applied entomology medical, veterinary*	*Applied entomology, forestry*
Alberta		+				
British Columbia	+		+			+
Carleton		+				
Guelph			+	+		
Laval			+	+		+
Manitoba			+	+	+	
McGill			+	+		
Memorial	+					
Montreal	+					
Québec à Montréal				+		
Simon Fraser			+	+		+
Toronto	+	+	+			
Waterloo		+	+			
Western Ontario	+					
York	+					

SOURCE OF GRADUATE STUDENTS

All graduate schools providing information on field of research of graduate students also provided information on source of students. Table 8 shows Canadian source institutions of students in Masters', and Ph.D. programs respectively. At the Masters level 53% of students are in the same institution as that in which they took their bachelor's degree; often these students did change departments within the university. At the Ph.D. level, 38% of students remained at the same University as that of their previous degree; most of these students probably remained in the same department. The proportion of foreign students (students whose previous degree was non-Canadian) was 10% for Masters students and 23% for Ph.D. students. Regional differences in movement are noticeable. In the Maritimes students either remain at the same university or leave the region entirely. In Québec the percentage of students entering the region to undertake Ph.D. study is lower than elsewhere. However, both Québec and Ontario have low percentages of M.Sc. entrants from other provinces. In the prairies at the Ph.D. level no students change university within the same province, because frequently this is not possible; the proportion of foreign students at the Ph.D. level is high in the prairies. In British Columbia, although there is considerable exchange between the universities at Masters' entrance, there is little exchange at Ph.D. entrance.

The source institutions for graduate students are of interest: students are unlikely to do graduate work in entomology if they have received poor training or no training at the undergraduate level. Hence a high number of students proceeding to graduate school from a university implies exposure during the first degree to courses and professors which foster interest in entomology. Table 9 indicates the most frequent source institutions for graduate students. Also shown are lists of the most frequent sources of students who move from one institution to another. These were included because the number of students entering graduate programs in the same institution may be considerably influenced by size of the graduate school rather than source-related properties of the institution. It is noticeable that the lists in Table 9 include institutions which have not appeared on the lists of institutions offering the most courses at the undergraduate or graduate level or having the most graduate students. In particular the importance of the University of Waterloo as a source of Ph.D. candidates could not have been predicted from previous data.

The data collected do not allow the identification of undergraduate courses taken by students entering graduate school, but it is possible to examine the maximum entomology C.U.'s a student entering a master's program could have taken. For 164 master's students for which there are data, 18% came from institutions offering 0 or 1 C.U. in entomology, 40% from institutions offering 2-5 C.U., and 43% from the eight campuses offering more than 5 C.U. of entomology. However, some students from these eight campuses were identified as not majoring in entomology (or its equivalent) in their first degree; hence no more than 33% of students entering master's programs had undergraduate programs with more than 5 C.U. of entomology. A similar analysis of Ph.D. entrants is not possible because it is now known how many of these held M.Sc. degrees and how many entered directly from their B.Sc. programs.

The source institutions outside Canada of entomology students in Canadian graduate schools were classified only by country. The most frequently reported source countries are United Kingdom, United States, and India. The data collected do not allow source of a student to be related to that student's field of study. A tempting hypothesis is that students from "third world" countries would be more likely to study applied entomology than would other foreign students. Universities are classified on the basis of areas of concentration given in Table 7, and countries are classified into those with national per capita daily caloric intake of greater than 2,500 and those with less (Bartholomew *et al* 1980). Of the 14 students from countries with a caloric intake of less than 2,500, 10 attend universities with concentrations of graduate students in applied entomology: "crops, stored products", 4 attend universities without this specialization. From countries where caloric intake is over 2,500, 11 students attend universities with "applied entomology: crops, stored products" and 13 attend universities without this specialty. Nevertheless a statistical test shows no significant relationship between nutrient status or source country and whether or not "applied entomology: crops, stored products" is a specialty.

There is considerable variation in the pattern of foreign student recruitment among Canadian Universities. Nine of the 11 United States students attend graduate schools in Alberta or British Columbia, while eight of the 11 United Kingdom students are doing graduate work at Toronto, Queens or Guelph. The University of Manitoba has the highest proportion of foreign students in its graduate entomology programs, most of these are students with degrees from countries with low per capita caloric consumption. Canada can make an important contribution to the education of entomologists from less developed nations where these skills are vital. But in the final analysis Canada's projected goals for food and forest products and for managing other natural resources requires that training of sufficient entomologists for its own needs be sustained and, where possible, enhanced.

Table 8. Source of graduate students in entomological fields.

	Master's Programs					*Ph. D. Programs*				
	Total Number	*% Same Institution*	*% Moved Within Province*	*% Other Province*	*% Foreign*	*Total Number*	*% Same Institution*	*% Moved Within Province*	*% Other Province*	*% Foreign*
Maritimes	9	44	0	22	33	2	0	0	100	0
Quebec	52	69	15	10	6	27	52	30	7	11
Ontario	63	51	25	12	11	52	35	23	21	21
Prairies	21	57	10	29	5	26	27	0	31	42
B.C.	38[1]	37	24	26	13	24	50	4	17	29
Canada	183	55	19	17	11	131	40	16	21	24

[1] Includes 15 M.P.M. candidates.

Table 9. Universities providing largest numbers of students for graduate work in entomology. (1981-82 academic year)

Masters				*Doctorate*			
All Institutions		*Excluding students who do not move*		*All Institutions*		*Excluding students who do not move*	
Guelph	17[1]	B.C.	6	B.C.	11	Waterloo	7
Laval	15	Guelph	5	Waterloo	10	B.C.	6
B.C.	13	McGill	4	Montréal	9	Alberta	4
Manitoba	10	Qué. à Montréal	4	Carleton	8	Carleton	4
Montréal	10	Victoria	4	Manitoba	8	Montréal	4
Qué. à Montréal	10	Montréal	3	McGill	7	Manitoba	3
Simon Fraser	10	Ottawa	3	Simon Fraser	7	Brock	2
Toronto	7	Toronto	3	Alberta	6	Dalhousie	2
York	6			Qué. à Montréal	4	Guelph	2
				Toronto	4	Ottawa	2

[1] Number of students from source shown.

CONCLUSIONS

1. At the national level, two deficiencies in university programs in entomology are identified: Insect pathology is a neglected field of study in Canada, at both undergraduate and graduate levels. Toxicology, arthropods other than insects, and taxonomy of insect larvae receive formal treatment at few institutions.
2. On a regional basis, excluding the Territories, the Maritimes are least well endowed in terms of university-level entomology courses and programs. Data available show that most provinces other than the Maritimes, have at least one university with significant offerings in entomology, at both graduate and undergraduate levels.
3. Graduate students tend to be distributed among institutions in a clumped pattern by specialty.
4. The principal source institutions for Canadian graduate students in entomology are those with significant undergraduate programs in this field.
5. Most M.Sc. students take this degree at the same institution at which the Bachelor's degree was taken. Most Ph.D. students take their degrees at institutions different from those at which the previous degree was taken.
6. Other source institutions for graduate students in entomology are primarily in India, the United Kingdom, and the United States, with a few students representing an additional 16 countries.

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