Proceedings of the Thirty-Third Annual Meeting of the

Entomological Society of Alberta

October 17-19, 1985
Sandman Inn
Lethbridge, Alberta

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Editor: W. A. Charnetski

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PRESIDENT'S REPORT

Entomological Society of Alberta

On behalf of the executives of the Entomological Society of Alberta, a warm welcome to old and new members, friends, and visitors to our 33rd Annual General Meeting here in the beautiful City of Lethbridge, which this year is celebrating its 100th Anniversary.

My last official duty as outgoing president is to report to you on the highlights of our activities in 1985. Our 33rd year has been relatively stable and rather unspectacular. The growth trends are heartening but job prospects remain rather lukewarm for graduating entomologists, while on the other hand, the retirements in the entomological profession continue with what seems few replacements. In spite of this, it is most heartening to see the participation of so many students. This augurs well for the Society and reflects the bonds of understanding between students and professors and the encouragement for input into the Society.

The task of President was made particularly light since so many hands helped pave the way. I would like to take this opportunity to extend my appreciation to the other members of the executive for their valuable time, effort, and commitment in support of our Society. As well, the response from past executives and members has been particularly gratifying. Without wishing to embarrass him, I must tip my hat for the unstinting contribution and continued effort of Robert Holmberg, our Secretary-Treasurer, who carried a big load, both for the Society and personally, in spite of which he worked tirelessly and with smiling good humor for the well-being of the Society. Our most sincere thanks, Robert. It was an honor and a pleasure to be president of the Entomological Society of Alberta in 1985. I would like to express my most sincere thanks to all who contributed to the success of the Society during the past year and to all members for their support and commitment.

J. A. Drouin
Entomological Society of Alberta

TIME'S ARROW AND THE WEB OF HUMAN EXISTENCE: TRENDS AND DRIVING FORCES IN DEVELOPMENT OF ENTOMOLOGY IN ALBERTA'S POST-SECONDARY EDUCATIONAL INSTITUTIONS

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Introduction

The title of this essay has to do with my concept of history, and history is what I am writing about. Henry Ford, in one of his less perceptive moments, defined history as "bunk". The Emperor Napoleon described history as a generally accepted fiction, which is akin to stating that objective accounts of human affairs cannot be written. I doubt that. Rather, I think that because human affairs are highly complex, it is difficult to establish causes and effects of all actions and events. Some efforts to do so have been self-serving, perhaps leading to Napoleon's pessimistic appraisal of history; and some historians have been notably unsuccessful, perhaps causing the outraged appraisal by Ford. In spite of the inherent difficulties, I think it is essential to make the effort to provide a reasonably objective account of our past, to pay tribute and to give thanks to our predecessors, and to discover patterns that might be repetitive, the appreciation of which might serve as guides in future actions.

I think of history as an arrow passing through time, drawing behind a long thread which is woven into a web. The strands of the web are interrelations among individuals and institutions, each of which is located at one of the junctures where the woven strands meet. For the purposes of discussion and analysis, a portion of the web is considered in isolation from the rest of it. The portion that I isolate here concerns entomology and the forces that seem to have shaped its development in the post-secondary educational institutions of Alberta.

Driving forces are those events and actions of individuals, which, when correlated with the inferred historical trends, have a causative or important effect upon the direction of the trends.

Those who hope to find here an account with the main focus on individuals who developed educational aspects of entomology in Alberta will be disappointed. Such an account for the Department of Entomology, University of Alberta, was published elsewhere (Ball, 1985). Interested individuals might also wish to consult Brian Hocking's (1964) earlier account of the Department. Another source of information about the department is in Heming (1972). For photographs of many of those who have been associated with post-secondary entomological education in Alberta, the annual Proceedings of the Entomological Society of Alberta (1953-84) should be examined.

Paul Riegert (1980) suggested that the history of professional entomology in western Canada, at least until the 1940's, was an account of a battle between men and hordes of destructive insects that took such effective advantage of

food and fiber unintentionally made available to them through human effort in agriculture and forestry. However, at that time, there were also small cadres of western naturalists who were interested in taxonomic and ecological aspects of insects. These were the amateur entomologists who contributed so extensively to knowledge of the insect fauna of western Canada (Strickland, 1953; Riegert, 1977). In the following pages, all aspects of entomology are considered, for what Riegert regarded as the domain of amateurs in the late 19th and early 20th centuries has become part of professional entomology, and consequently is taught in the post-secondary institutions.

What I have to offer, will, I hope, be instructive and edifying to the present members of the Entomological Society of Alberta. I hope future historians will find in this account a basis to appreciate the circumstances which they will be attempting to understand, thus making rather less misty the journey into the past that they will undertake.

Organization of the Presentation

First, I deal with the events that concern the Department of Entomology, University of Alberta. Then I treat entomology as taught in other post-secondary institutions. The reasons for this division are two-fold. First, the Department of Entomology's mission is solely entomology, whereas the missions of other establishments teaching entomology are more diverse. Second, a disproportionate amount of information is available to me about my own Department, mainly because I have been a member of it for more than 30 years.

Although the focus of this essay is on educational institutions, I have had to deal with the extensive educational contributions of entomological institutions and entomologists whose primary roles were not educational. Failure to note these contributions might suggest, by implication, that educators in post-secondary institutions are unappreciative of them. They are not. Furthermore, as noted above, history is not simply linear but rather it is a network. This network becomes more evident by specific identification of its various components.

Historical Periods

For purposes of analysis and ease of comprehension, I recognize four episodes or periods of entomological history based on events at the University of Alberta, which are explained in detail elsewhere (Ball, 1985). The historical periods are of various lengths, ranging from 12 to 24 years, as follows:

1. Early Years (1922-45)
2. Post-War Years (1946-57)
3. Expansion (1958-70)
4. Consolidation (1971-present)

Future historians might discover that the fourth period, which I have extended to the present (1985), ended earlier, and that we are now in a fifth period.

These periods, though suitable for cataloguing and analyzing events at the University of Alberta, are rather less suitable for other provincial institutions. For example, the early years in the Period of Consolidation at the University of Alberta are years for expansion of entomology at the other institutions. However, to provide a common temporal base line for discussion, the same periods are used throughout the essay.

Entomology at the University of Alberta

Introduction

The history of the Department of Entomology at the University of Alberta began in 1922, with the appointment of Edgar Harold Strickland (1889-1962) as Department Head, in the Faculty of Agriculture (Hocking, 1963, 1964; Riegert, 1980). A man of scientific excellence, if not genius, industrious, well-organized, generous-hearted, well-spoken, and sympathetic to the requirements and aspirations of others, Colonel Strickland laid an excellent foundation for future development. This development is best seen as a series of trends involving the Department's major commitments to teaching and research.

Trends

Six trends are illustrated in five tables and one figure, and are discussed below.

Development of staff.--Table 1 illustrates development of departmental staff, in terms of periods during which new appointments were made. Totals at the bottom show the present numbers of staff in each of three categories. Totals at the right show numerical trends.

A marked increase is seen in all categories during the Period of Expansion. During the Period of Consolidation, increases occurred in the professorial and technical staff; the increase in professorial staff being one-quarter of that in the Period of Expansion; for the technical staff, the increase being three-quarters of that in the previous period.

These increases over the years meant an increased capability in teaching, research, and publication, and have been basic to the Department's ability to function effectively. See Harper (1979) for a bibliography which includes, by author, lists of these publications through 1977. Unpublished lists that are up-to-date may be obtained by request through the Chairman of the Department of Entomology.

Degrees awarded.- The number of degrees awarded is an index of activity in a teaching department. Table 2 shows by historical period the number of undergraduate and graduate degrees awarded, number of degrees in terms of length of each historical period, and the number of degrees in relation to the total number of staff.

Totals for number of degrees show a trend of increase to the Period of Expansion, and then a decrease. Totals at the bottom of Table 2 show that more graduate than undergraduate degrees have been awarded.

Table 1

NEW STAFF POSITIONS, DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, BY HISTORICAL PERIOD				
HISTORICAL PERIOD	TYPE OF STAFF POSITION			
	PROFESSORIAL	TECHNICAL	OFFICE	**TOTAL**
EARLY YEARS 1922-45	1			1
POST-WAR 1946-57	1	1	1	3
EXPANSION 1958-70	4	4	3	11
CONSOLIDATION 1971-85	1	3		4
TOTAL	7	8	4	19

Table 2

UNDERGRADUATE AND GRADUATE DEGREES AWARDED, DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, BY HISTORICAL PERIOD						
	NUMBER OF DEGREES AWARDED			Nº. YEARS IN HISTORICAL PERIOD	Nº. DEGREES / YEARS IN HISTORICAL PERIOD	Nº. DEGREES / TOTAL Nº. STAFF
	UNDERGRAD.	GRAD.	**TOTAL**			
EARLY YEARS 1922-45	18	4	22	24	0.92	22.00
POST-WAR 1946-57	25	10	35	12	2.92	8.75
EXPANSION 1958-70	22	44	66	13	5.08	4.40
CONSOLIDATION 1971-85	16	42	58	15	3.87	3.05
TOTAL	81	100	181			

Trends for undergraduate and graduate degrees show different temporal patterns: for undergraduate degrees, a decrease beginning in the Expansion Period; for graduate degrees, an increase to the Period of Expansion, and then a slight decrease in the Period of Consolidation.

Comparisons within periods show a marked change in number of each kind of degree awarded: in the Early Years and Post-War Years, undergraduate degrees predominate; during the Expansion and Consolidation Periods, graduate degrees predominate.

Changes in total numbers reflect enrolment and employment opportunities: these increased through the Period of Expansion, and decreased subsequently. Changes in proportions of undergraduate and graduate students reflect: 1) an influx of graduate students from elsewhere, and 2) a declining level of interest in entomology among undergraduates. The increase in number of degrees awarded from the Post-War Period through the Expansion Period must also be considered against general student enrolment at the University of Alberta; there was about a four-fold increase from 1957 to 1970.

Table 2 also shows that the number of degrees awarded, in terms of length of each period, increased through the Period of Expansion, then decreased. For the number of degrees awarded during each period in comparison with numbers of departmental staff, there was a steady increase. I am not sure what these figures mean, but I do not think they would please the former Premier of Ontario, William B. Davis, with his motto of "More scholar for the dollar"!

Source areas of graduate students.- I noted that Table 2 indicates that the Department of Entomology must have been recruiting graduate students from elsewhere because, while the number of undergraduates in entomology was declining, the number of graduate students was increasing. Thus, the former group could not have been the sole source of the latter. Table 3 indicates source areas for our graduate students. To simplify and consolidate the information, I used zoogeographical regions to groups students from localities outside of North America. North Americans were grouped into two categories: those from Canada and those from the United States. Totals at the right indicate the number of graduate students from each geograhical area recorded. Totals in the second row from the bottom indicate the temporal trend in numbers of graduate students.

Table 3 shows that all zoogeographical regions, except the Neotropical, have been represented among the graduate students of the Department of Entomology. These data indicate that the department has contributed to the development of an international scale. Absence of graduate students from the Neotropical Region is enigmatic, for many Latin American entomologists have taken graduate studies in other parts of the world.

Most foreign students came to the Department of Entomology during the Period of Expansion. The numbers declined during the Period of Consolidation. On the other hand, the percentage of Canadian graduate students declined through the Period of Expansion, increasing sharply during the Period of Consolidation.

These changes reflect two events that are themselves related: 1) the decrease in total number of graduate students is correlated with an economic decline in Canada, and 2) the change in proportion by source of area is correlated with

Table 3

NUMBERS OF GRADUATE STUDENTS, PERIOD OF INITIAL ENROLMENT, AND GEOGRAPHICAL SOURCE AREA, DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA

GEOGRAPHICAL SOURCE	HISTORICAL PERIOD				TOTAL
	EARLY YEARS 1922-45	POST-WAR 1946-57	EXPANSION 1958-70	CONSOLIDATION 1971-85	
CANADA	4	10	25	37	76
U.S.A.			7	4	11
PALAEARCTIC		2	17	2	21
AFROTROPICAL			1	4	5
ORIENTAL			13	2	15
AUSTRALIAN			2	3	5
TOTAL	4	12	65	52	133
PERCENT CANADIAN	100	83	38	71	57

Table 4

NUMBER OF THESES PRODUCED, DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, CLASSIFIED BY SUBJECT AREA AND PERIOD OF PRESENTATION

SUBJECT AREA OF THESES	HISTORICAL PERIOD				TOTAL
	EARLY YEARS 1922-1945	POST-WAR 1946-1957	EXPANSION 1958-1970	CONSOLIDATION 1971-1985	
ECOLOGY	3	7	12	16	38
SYSTEMATICS			12	15	27
PHYSIOLOGY		2	12	1	15
MORPHOLOGY			4	4	8
BIOCHEMISTRY			1	5	6
TOXICOLOGY-CONTROL		1	3	1	5
PUBLIC HEALTH	1				1
TOTAL	4	10	44	42	100

intensification of nationalism. As a result of this factor, it has become difficult for Canadians to go elsewhere, and for foreign graduate students to come here.

Areas of research by graduate students.--Table 4 indicates the subject area of theses by graduate students, in terms of numbers of theses in each area, by historical period. Totals at the bottom of the table show the trend in numbers of theses submitted. Totals at the right indicate relative interest in entomological fields by those who completed graduate work.

In the Early Years, work was conducted in only two fields; in the Post-War Period, in three fields; and in the Periods of Expansion and Consolidation, in six fields. Ecology has the longest history, followed by Physiology and Toxicology and Control. During the Period of Expansion and Consolidation, contributions to Ecology, Systematics, and Biochemistry increased, while contributions to Physiology and Toxicology declined, with morphology remaining constant. Overall, Ecology and Systematics attracted the greatest number of students.

Types of insects studies by graduate students.--Figure 1 is a graph, plotting numbers of theses classified in three groups according to pest status of insects studied, in each historical period. The graph shows that only pest species were investigated during the Early and Post-War Years, with studies of such groups peaking during the Period of Expansion, and declining during the Period of Consolidation. On the other hand, during the Period of Expansion, non-pest insects served as the basis for 25 theses, and the number of such theses increased during the Period of Consolidation.

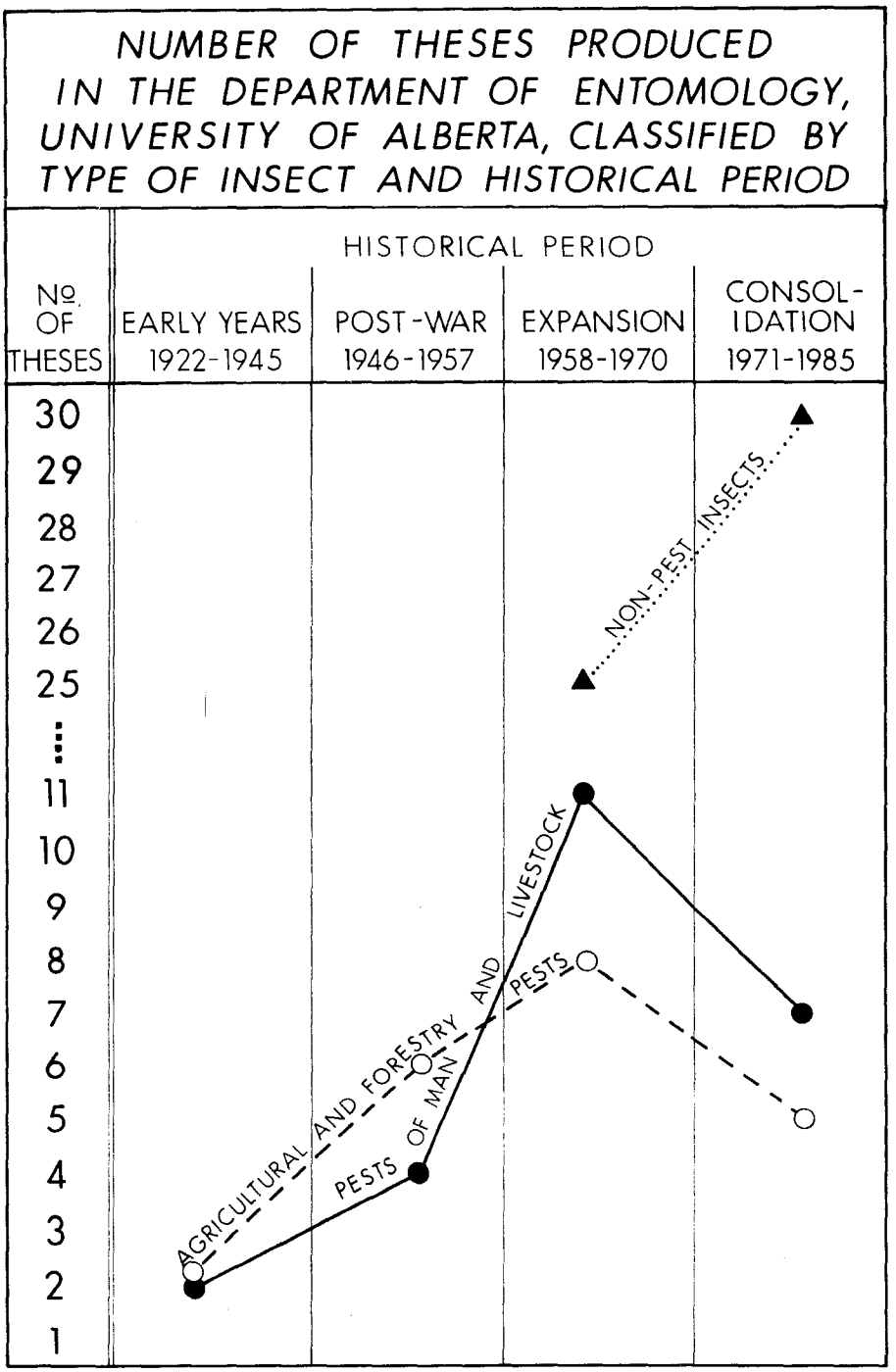
Figure 1 reflects two things about Departmental policy: first, selection of students with their own ideas about what they want to do; and second, insistence upon basic research, as opposed to applied research per se. Also reflected is general avoidance by faculty members of contract-supported research, with its attendant requirements for work on pest species in specified economic areas.

With a shift in attitude about regulation of insect numbers from use of anti-biological methods to a more holistic approach, it is likely that there will be a shift over the years to increased work on pest species. In fact, we are already witnessing development of this trend.

Post-doctoral fellows.--Although the major portion of the Department of Entomology's program has focused on graduate students, the Department has also sponsored post-doctoral fellows (PDFs). Table 5 shows numbers and trends in foreign and Canadian PDFs. Totals at the right contrast numbers of Canadian and foreign PDFs; those at bottom show the trend in total numbers by historical period.

There was a marked increase from period to period, from zero in the Early Years, to 10 during the Period of Consolidation. During the Period of Consolidation, the number of foreign PDFs declined, while the number of Canadians rose from zero to seven. These data are a straight reflection of the current employment situation and economic nationalism, alluded to previously.

Figure 1


NUMBER OF THESES PRODUCED IN THE DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, CLASSIFIED BY TYPE OF INSECT AND HISTORICAL PERIOD
HISTORICAL PERIOD
No. OF THESES
EARLY YEARS 1922-1945
POST-WAR 1946-1957
EXPANSION 1958-1970
CONSOL-IDATION 1971-1985
30
29
28
27
26
25
11
10
9
8
7
6
5
4
3
2
1
NON-PEST INSECTS
AGRICULTURAL AND FORESTRY PESTS
LIVESTOCK AND PESTS OF MAN

Employment of graduates of the Department of Entomology.--The contribution that a teaching department makes can be assessed, at least partially, in terms of employment of its graduates. A more detailed analysis (Ball, 1985; 5, Table 3) served as the basis for Table 6. This shows that of 181 students, 64% are employed in the public sector (government service, universities, and secondary education), while only 19% are in the private sector. The remainder are self-employed (some of these are graduate students, others are consultants, or are without steady employment). These data indicate clearly that the public sector offers the best opportunity for employment of entomologists, with the implication that as this sector waxes and wanes, so will entomology.

Summary of trends.--Three trends indicate increases through the Period of Expansion, followed by decrease during the Period of Consolidation: the number of degrees awarded in entomology; the number of foreign graduate students; and the number of theses based on pest species of insects. Three trends indicate increase into the Period of Consolidation: the number of staff members in the Department of Entomology; the number of Post-Doctoral Fellows; and the number of theses about non-pest species of insects. One trend, the number of subject areas represented by theses, exhibits an increase into the Period of Expansion, with no changes into the Period of Consolidation.

Driving Forces

In the affairs of men, trends just do not happen of themselves; there are reasons for them. If we are able to understand the trends, the reasons for them must be sought. Analysis of trends is more or less speculative, for explanations are based principally on correlations with events classified as driving forces. The present analysis has some highly speculative elements in it, though some are virtually self-evident.

I think there are two groups of driving forces: those from outside an institution and those from inside. I identify and comment on the components of both groups.

External driving forces.--These include agriculture, persons, economics, politics, and human relations.

Riegert (1980) provides an extensive description of the effect of the opening of Western Canada on the development of agriculture. Various important pests soon made their appearance, and in turn their activities required the efforts of entomologists. As noted above, Strickland came to Alberta, and in due course established the Department of Entomology at the University of Alberta. But not only did insect pests of plants and livestock lead indirectly to the foundation of the Department, the problems they caused formed a substantial part of the Department's research agenda during the Early and Post-War Years. In fact, the need to control pest species was a major driving force in the development of entomology in Western Canada.

The persons from outside the Department of Entomology who had major indirect effects were C. Gordon Hewitt (1885-1920), and Kenneth W. Neatby (1900-58). Both are well-known in Canadian agricultural circles, and their general contributions are described by Riegert (1980). Hewitt founded the Entomology Research Branch, separating it from the Experimental Farm Division of the

Table 5

POST-DOCTORAL FELLOWS, DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, NUMBERS AND SOURCES

NATIONAL SOURCE	HISTORICAL PERIOD				TOTAL
	EARLY YEARS 1922-45	POST-WAR 1946-57	EXPANSION 1958-70	CONSOLIDATION 1971-85	
FOREIGN		1	5	3	9
CANADIAN				7	7
TOTAL		1	5	10	16

Table 6

EMPLOYERS OF GRADUATES OF THE DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF ALBERTA, 1925-1985

PUBLIC SECTOR					PRIVATE SECTOR				UNKNOWN
GOVERNMENT		UNIVERSITIES		TEACHING	INDUSTRY		SELF EMPL.	GRAD. STUDENT	"
ENT.	NON ENT.	PROFS.	OTHER	SECONDARY SCHOOLS	ENT.	NON ENT.	"	"	"
54	11	36	6	9	4	1	21	9	30

Total: 181 % PUBLIC SECTOR = 64 % PRIVATE SECTOR = 19

Canada Department of Agriculture. This action made possible the expansion of entomology through employment of additional entomologists. Hewitt also employed Strickland, who established a laboratory at Lethbridge before he accepted a position at the University of Alberta. Early expansion of entomological activity by the federal government was especially important during the early years of the Department of Entomology, making possible employment for at least a few entomologists.

During the Post-War Period, K. W. Neatby became Director of Science Service, and his efforts made possible the accelerated development of scientific agriculture. This led to expansion of the Agriculture Research Service, with many positions for entomologists, a fair share of whom had taken their degrees at the University of Alberta, working under Strickland and Hocking. However, there was another effect on the Department of Entomology resulting from the expansion of the entomological arm of the federal government. This service was now able to deal more effectively with pest problems that had previously absorbed most of the attention of not only federal entomologists in the prairies, but also those in the universities. Thus, entomologists in the universities were able to concentrate on other aspects of entomology, and this freedom is reflected in the diversity of studies that characterizes the Periods of Expansion and Consolidation in the University of Alberta's Department of Entomology.

Economic factors affected the Department of Entomology both positively and negatively. During the Depression of the 1930's, the economy was such that there were few openings in the federal service, and few jobs for entomologists. Probably a clear reflection of this state of affairs is the small number of individuals, who, during the Early Years took degrees in entomology. Similarly, the recession and depression of the 1970's and 1980's led to a slowed growth in the productive elements of the public sector, reducing employment possibilities for entomologists. I think this contributed to the decline in enrolments in entomology at the beginning of the Period of Consolidation.

In the field of politics, international relations among unfriendly and friendly nations exerted influence on development of entomology. Between unfriendly nations, World War II took place, leading in part to an increased interest in medical entomology, and eventually to marked interest in intensive work on biting flies, especially during the Post-War Period. This led to employment opportunities, and provided one of the major foci of interest for the Department of Entomology.

The successful launching of the space satellite, Sputnik, by scientists of the U.S.S.R. in 1957 led to a major increase of investment in science, in general, especially among nations of the Western Alliance. This show of interest had nothing to do with the search for truth and understanding for its own sake, but rather it reflected concern about consequences resulting from the successful initiative of the Russians in reaching outer space. This development preceded slightly the Period of Expansion of the Department of Entomology, which in turn was part of a general expansion of the science program at the University of Alberta.

One of the principal sources of financial support for research in the universities was the National Research Council, whose granting function was

largely taken over in the 1970's by the Natural Sciences and Engineering Research Council of Canada. Through these agencies, the federal government funded scientific research, the amount of support fluctuating as government interest in encouraging research waxed and waned. Whatever the circumstances, however, an enlightened policy was followed in an effort to develop and maintain excellence in science in Canada. This funding made possible much of the research work carried out in the Department of Entomology. Beginning in the Period of Expansion, funding was especially generous, and has been adequate during the Period of Consolidation.

Among friendly nations, following World War II, a period of prosperity and concern for developing nations, by those nations regarded as developed, led to international scholarships and the easy passage of citizens from one country to another. These events coincided with the Department of Entomology's Period of Expansion.

Subsequently, as financial difficulties followed in the wake of the artificially created oil crisis in the Middle East, a period of economic nationalism developed, coinciding with the Department's Period of Consolidation. During this time, financial support for universities declined, as did the possibility of support for non-Canadian students.

If international affairs exerted effects on the Department of Entomology, so did national issues. One of the most important issues was environmental pollution, attention to which was drawn by Rachel Carson's "Silent Spring", published in 1962. This forced attention on ecology, and provided additional impetus to study organisms in their natural environments. It also had a negative influence on economic entomology, as it was practised during the 1950's and 1960's. Concern started with persistent chemical biocides and extended to other forms of environmental pollution. Certainly, this turn of events did nothing to deflect the Department's major interest in ecology; indeed, several theses were produced whose focus was the study of biocides in the environment, and various individuals took an active role in efforts to encourage governmental monitoring of the use of chemical biocides as regulators of animal and plant pest populations.

Another political development whose effects are now being felt is that of supply-side economics, associated with the revolt of the wealthy and powerful. This is leading to a general weakening of the public service, and will eventually have a higher detrimental effect on the development of science, including entomology, in Canada.

Size of the Canadian population has affected development of universities and thus the Department of Entomology. Following the conclusion of World War II, veterans seeking educational opportunities flooded the underfunded and understaffed universities. The pressure was such that additional staff had to be employed. The following period of prosperity allowed many more to attend university, which resulted in a large university population, and required an expanded staff. The demand for highly skilled personnel provided employment for individuals with university training, and provided incentive to acquire this training. Also, at this time, persons who were part of the "baby boom" that marked the aftermath of World War II reached the age to attend university. These events were associated with the Post-War and Expansion Periods of the Department of Entomology.

However, the population bubble eventually burst, with the consequent decline in student numbers setting off a period of university cutbacks and retrenchment. For the Department of Entomology, this decline marked the end of the Period of Expansion, and the beginning of the Consolidation Period.

Internal driving forces.--These include persons, finances, and curiosity about insects.

Two persons in the Department were principally responsible for its present form. Colonel Strickland laid sound foundations, and Brian Hocking, the second Head (and later Chairman) roughed out its dimensions and structure. It is principally because of Professor Hocking's direction that our holdings and operations are what they are today.

Brian Hocking was involved in selection of all, except one, of the present faculty members. Under his direction, each faculty member had a voice in departmental governance, and out of this came a policy statement requiring, above all, that the Department maintain a faculty of sufficient collective breadth of expertise to range across the field of entomology.

No matter how good a chairman might be, he cannot function without collegial support. Some of the most effective support received was from A. G. McCalla when he was Dean of the Faculty of Agriculture. Dean McCalla determined that the Faculty would develop basic research in agriculturally related fields, and he and Hocking were kindred spirits. McCalla's influence was especially important at the beginning of the Department's Period of Expansion.

No matter how good and how determined a chairman might be, and no matter how well he is supported intellectually by his Dean, without financial support is limited in what he can do. Over the years, thanks to a series of friendly, cooperative, and competent Deans, the Department of Entomology has received its fair share of university resources. During the years of adequate funding, the Department was able to expand to achieve its goals of coverage and expertise. During the years of fiscal restraint, coinciding approximately with the Period of Consolidation, the Department has received enough to maintain its operations.

Perhaps the most pervasive driving force in development of the Department of Entomology is that of intellectual curiosity--the desire to learn about insects. More than any other criterion, this is the one that we expect applicants to our graduate program to indicate. We want original research proposals in an area in which each individual wishes to work. This procedure has led to the diversity of subject areas about which theses have been written. Curiosity about insects is the life blood of the Department.

Entomology at Other Post-Secondary Educational Institutions in Alberta

Ten post-secondary educational institutions have entomologists in their Biology Departments, but entomology is offered in only six, as follows: Camrose Lutheran College, Camrose; Canadian Union College, College Heights; Northern Alberta Institute of Technology, Edmonton; Olds College, Olds; Red Deer College, Red Deer; and the University of Calgary, Calgary.

Educational requirements of the province in the 1950's and 1960's were met by development of additional post-secondary institutions. Some of these recognized that entomology courses could contribute to breadth in biological knowledge. For others, such as the Northern Alberta Institute of Technology and Olds College, entomology was an integral part of core curricula.

Although entomologists are on staff at the following institutions, entomology courses are not offered: Athabasca University, Athabasca; Medicine Hat College, Medicine Hat; Mount Royal College, Calgary; and the University of Lethbridge, Lethbridge.

Courses offered in entomology are mostly restricted to introductory entomology, and at NAIT, a course in taxonomy is also offered.

Table 7 shows that most entomologists employed by educational institutions, other than the University of Alberta, joined the staff during or after the late 1950's. This is expected, for most of these institutions were established during this period. These teachers exhibit a diversity of entomological interests, with interest in pest species of insects being predominant. I offer more detailed comments about two of the institutions, with a longer history in entomology.

Olds College.--Table 8 shows a gradual increase in the number of entomologists at Olds College, and in the number of courses taught. The highest numbers were reached during the period 1971-85. Table 9 provides additional details, indicating not only the times when various course were given, but also the names of the teachers.

The University of Calgary.--This university has an informal entomology program in the Department of Biology. The first entomologist, Richard Hartland-Rowe, joined the faculty in 1959. In 1967, Gordon Pritchard joined the faculty, and was followed in 1984 by R. E. Owen. Although the Department of Biology has a limited offering in courses in entomology, during the past 25 years, 16 individuals have completed Master's and Doctoral programs with theses based on entomological topics, as indicated in Table 10. Like the Department of Entomology at Edmonton, most of the theses have addressed ecological topics.

The driving force in the development of entomology at the University of Calgary has been one entomologist, Gordon Pritchard. His motivation stems from the same wellsprings that motivate his Edmonton colleagues--curiosity about and interest in insects in living beings.

The Alberta Provincial Museum

Museums are partially, at least, teaching institutions, and so it is appropriate to consider the Alberta Provincial Museum in this essay. In 1983, this institution added an entomologist to its staff, Dr. Albert Finnamore. His efforts will enhance appreciably the educational aspects of entomology in this province.

Table 7

NUMBER OF ENTOMOLOGISTS AND THEIR INTERESTS, IN ALBERTA POST-SECONDARY INSTITUTIONS OTHER THAN THE UNIVERSITY OF ALBERTA, AND IN THE PROVINCIAL MUSEUM

HISTORICAL PERIOD	PRIMARY ENTOMOLOGICAL INTEREST					TOTAL
	Applied Ent. Agriculture	Ecology General	Biting Flies	Systematics	Unknown	
1971-85	5	2	2	1*	1	11
1958-70	1	2	1	1		5
1946-57						
1922-45	1					1
TOTAL	7	4	3	2	1	17

* Alberta Provincial Museum

Table 8

ENTOMOLOGY AT OLDS COLLEGE, ALBERTA: NUMBER OF TEACHERS AND NUMBER OF COURSES BY HISTORICAL PERIOD

HISTORICAL PERIOD	NUMBER OF:	
	TEACHERS	COURSES
1971-1985	3	4
1958-1970	2	3
1946-1957	1	1
1922-1945	1	1-2*

*Apiculture taught 1941-45

Table 9

ENTOMOLOGY AT OLDS COLLEGE, ALBERTA: TEACHERS, COURSES, AND DATES OF OFFERING

TEACHER (Appt. Date)	COURSES AND DATES OF OFFERING			
	Field Crops Entomology	Apiculture	Horticultural Entomology	Int. Pest Management
YAUCH, C. (1921)	1921-	1941-45		
GODWIN, B. (1963)	1965-76	1960^{s}-70^{s}	1963-79	
PARKER, K. (1967)		1970^{s}-81		
MENGERSON, E. (1976)	1977-		1980-	1981-
LEISCHNER, T. (1981)		1981-		

Table 10

NUMBER OF ENTOMOLOGICAL THESES PRODUCED - DEPARTMENT OF BIOLOGY, UNIVERSITY OF CALGARY - CLASSIFIED BY SUBJECT AREA AND PERIOD OF PRESENTATION

SUBJECT AREA OF THESIS		NUMBER OF THESES HISTORICAL PERIOD	
		-1970	1971-1985
ECOLOGY	Biting Flies		2
	Other Insects	2	10
PHYSIOLOGY			3
SYSTEMATICS			1
TOTAL		2	16

Entomological Education and Non-Educational Institutions

Entomological institutions whose primary missions are non-educational have participated in the educational process. Federal, provincial, and civic institutions that hire students for summer work in entomology programs contribute to their education. The federal agricultural and forestry laboratories have contributed in this way for many years. They were especially important during the period of the Early and Post-War Years, becoming less so more recently, as funding for students during the summer months became available from other sources, and as increased diversity in graduate programs required that such individuals be elsewhere than in laboratories devoted primarily to study and control of pest species. It remains for someone else to document in detail the educational role of these institutions, but their important contributions to education are both recognized and appreciated, if seldom acknowledged, by educators. Of special importance to the students of the Department of Entomology, University of Alberta, have been the Entomology Sections of the Lethbridge Research Station, and the Forestry Laboratory, initially at Calgary and more recently at Edmonton.

Individuals Associated with Non-Educational Institutions

Many workers in laboratories in non-educational institutions have contributed to the education of entomologists. Hewitt (quoted by Riegert, 1980: 319) made this point, while writing in 1915 about the early entomologists in the federal service: "You cannot fail to observe the single motive that runs through all their efforts--an unquenchable desire to place scientific knowledge at the disposal of those who will profit by its application to the advantage of the country at large." I note three individuals by name: Mr. John H. (Jack) Brown, now deceased, having previously retired from long service as Alberta Provincial Public Health Entomologist; and Drs. Ruby I. Larson and Reginald W. (Reg) Salt, Lethbridge Research Station, now retired following distinguished careers as cereal grain geneticist and entomologist, respectively. The contributions to post-secondary entomological education by Salt and Brown were direct, for each taught entomology at the University of Alberta. During World War II, Colonel Strickland returned to duty with the Canadian Army, thus temporarily vacating his university position. Reg Salt, on leave from his position at Lethbridge with the Canada Department of Agriculture, took Strickland's place temporarily, from the fall of 1940 until the spring of 1942. Similarly, Jack Brown, on leave from his position with the Government of Alberta, occupied Strickland's position from the fall of 1942 through 1944.

Ruby Larson's contribution to post-secondary education was indirect. Through her fine Junior Science Club, several bright individuals found their way into entomology, and many others developed their talents in other professions. Those who were unaware of her efforts in education would do well to read the tribute offered to her by Brian Hocking (1973). Her contributions were recognized by our Society in 1979, when she was elected an honorary member. In comparing her results with those attained by institutions of higher learning, one must come to the often noted conclusion that education is far too important a matter to be left in the hands of professional educators alone.

The Entomological Society of Alberta

It would not do to write about entomological education in this province without alluding to the contribution that our own Society has made. For the past thirty or so years, monetary prizes have been awarded to first-rank students in entomology at the University of Alberta and the University of Calgary. Our annual meetings have provided admirable training grounds, for graduate students have the opportunity there to present their first scientific talks to small, friendly, and interested audiences.

Contributions of Amateur Entomologists to Post-Secondary Educational Institutions

Two kinds of contributions have been rendered by amateur entomologists in Alberta: donations of prepared specimens of insects to post-secondary educational institutions; and assistance to students through consultation, guidance on collecting trips, and gifts of specimens. The Department of Entomology, University of Alberta, was the fortunate recipient of such collections. Frederick S. Carr's (1881-1934) excellent contribution of North American Coleoptera was donated in 1939, by his widow. This collection is the nucleus of the Department's holdings of adult Coleoptera.

Following the death of Kenneth Bowman (1875-1955), his widow donated to the department the excellent collection of adult Lepidoptera of Alberta that he had assembled during his lifetime. His brief obituary (Anon., 1955) concludes thus: "If the Society can raise one amateur to emulate him in a generation, it will serve its purpose well." The department also received a collection of adult Lepidoptera from Donald Mackie, who, for many years, was Registrar of Births, Marriages, and Deaths for the Province of Alberta (Strickland, 1953). (See Strickland, 1953: 8-9 for appraisals of both Carr's and Bowman's entomological work in Alberta.)

The contributions of Dr. J. L. Carr (F. S. Carr's son) and his wife, Alberta, who have assembled an impressive collection of North American beetles and who are very knowledgable coleopterists, have been of enormous help to graduate students in systematic entomology at the University of Alberta and the University of Calgary.

The Network of Entomological Education in Western Canada

I am not able to address this topic in the detail that it deserves, but I want to note it for the attention of future individuals who may write about this aspect of entomological history. The network consists of interactions among entomologists in the teaching institutions of this area, including movements of professors and students from one institution to another. It will be a very complex topic. Riegert (1980: 312) provides a general context, with this moving statement: "When reflecting upon entomology within the universities of Western Canada during the first forty years of this century, one is immediately impressed by the prominence of individual entomologists as teachers: Mitchener of Manitoba, Saunders and Rempel of Saskatchewan, Strickland of Alberta, and Spencer of British Columbia. Their enthusiasm for entomology, their boundless capacity to instill in students a knowledge of insects, and their ability to

acquaint a nation with the values of insect control, were the cornerstones on which this branch of biology was built. Their legacy still spreads throughout the land--a great lone land which has now created its own identity."

Summary of Accomplishments

Collectively, over the past sixty-odd years, entomologists of this province engaged in education have provided opportunities to those who came, seeking to learn about insects. These opportunities were given formally in courses and in degree programs, informally in other ways. Most students who became competent entomologists have become part of the public service devoted to teaching, research, and extension. The research of educators and students has been of appreciable significance in furthering understanding of insects.

The Future

The attempt to identify trends and their causes poses hazards because the points that seem to fall in reasonably neat lines may not really do so. Furthermore, even if the trends are correctly identified the correlation between them and the putative driving forces might be spurious. Another magnitude is added to the risk of error by attempting to project the trends some way into the future. It seems to me that the risk is worth taking. Right or wrong, such projections focus our thinking on the future rather than on the present, and having the longer perspective ought to serve us well in charting a course.

The number of students attracted to the study of insects is of considerable interest to teachers and departments of enotmology, because of a desire to teach the subject to as large an audience as possible, and to help in providing future generations of entomologists. In turn, students are attracted to entomology both by innate interest and by employment possibilities. With the present rather low demand for entomologists in the public service, I believe the decline in numbers of students taking degrees in entomology will continue. In turn, declining enrolments will prevent growth in post-secondary entomology programs and breadth of research will be reduced. Under these circumstances, it is unlikely that entomology programs will be initiated in those provincial institutions which do not already offer courses in this subject, and in some institutions such programs could be discontinued.

Nonetheless, under some circumstances, more entomologists might be hired. For example, increased interest in protection and wise use of renewable natural resources (Wiggins, 1983) ought to lead to studies of entomological aspects of aquatic ecosystems and soils (Spence and McGill, 1985). Developing biological control capabilities will require numerous new appointments in fields ranging from systematics to biotechnology. The current concern about acid rain could lead to investigations of entomological aspects of this ecological disaster, requiring employment of individuals with entomological expertise. Do I think that there will be an increase in the public service to deal with these problems and projects in the immediate future? Do pigs fly? In the present economic climate, with representatives of major corporations in line at the public counting house to obtain largesse doled out by governments devoted to anachronistic economic policies, there is little left for improvements or expansion in the public service.

More specifically, the Department of Entomology at the University of Alberta will retain its current diversity of interests in teaching and research. I believe that the staff will remain at about its present size, but as the older members retire, they will not necessarily be replaced by individuals with the same specific interests. Just what their specialties will be is difficult to forecast. The same general types of undergraduate and graduate programs will be continued and revised as required to keep pace with the ever-increasing tidal wave of knowledge about insects. Graduate students will continue to have the opportunity to do research in entomological areas that are of interest to them.

Entomologists not in educational institutions will also continue to be active in the educational process, as they have been in the past. And, if the funding of post-secondary educational institutions continues to decrease, the assistance of those entomologists outside such institutions is likely to be sought more frequently. Hopefully, they will respond, just as Reg Salt and Jack Brown did during the years of the Second World War.

Finally, I suggest that entomology will continue to flourish in Alberta, in spite of the present economic restraints placed on its professional components. This is because of the intense interest of the practitioners, who will continue to contribute to entomology, both through study and through encouragement of those members of succeeding generations who will also want to take up pursuit of the smallest game.

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A preliminary draft of this essay was critically reviewed by my colleagues, D. A. Craig and R. H. Gooding. Acceptance of their numerous suggestions and corrections required changes that led to a much improved manuscript. I thank them for their assistance.

I will also take this opportunity to thank the members of the audience who sat through an overly long oral presentation of a preliminary version of this essay, and who responded with generous applause. I was thus encouraged to face the task of preparing the written version.

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INSECTS AND SCIENTISTS: A HISTORY OF PROFESSIONAL ENTOMOLOGY IN FEDERAL GOVERNMENT DEPARTMENTS IN ALBERTA

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The Beginning

The Federal Government first became involved with insects in Alberta when the province was still part of the Northwest Territories. In 1883, James Fletcher, an accountant, working in the Library of Parliament, was appointed Honorary Entomologist to the Dominion Department of Agriculture. In 1884, Fletcher was appointed Dominion Entomologist, and in 1887, he became Dominion Entomologist and Botanist. Because Fletcher had no assistants and because his duties as an accountant continued for four years, he corresponded with a large number of amateur naturalists who helped him with his entomological work. Fletcher knew that amateurs could be very valuable because he had no professional biological training himself but he loved nature and had trained himself to be an outstanding entomologist and botanist.

Among Fletcher's correspondents were a group of amateur entomologists from the Calgary-Red Deer area of the Northwest Territories who started the Northwest (Canada) Entomological Society (1898-1902) and its successors, the Territorial Natural History Society (1903-05) and the Alberta Natural History Society started in 1906. Fletcher not only corresponded with these naturalists and became an honorary member of their Society, he also visited them on his trips across Canada. Fletcher also donated prizes to be awarded at the Society's annual meeting for the best student's collection of insects in the Northwest Territories.

Fletcher encouraged members of the Society to report insect occurrences to him and to collect specimens for museums. They did more than that; they lectured at schools and started Field Clubs for nature study, set up entomological and botanical displays at fairs, identified insects for ranchers, farmers, and gardeners, and advised the public on insect control. Some members were quite knowledgeable. W. H. Wolley-Dod, a farmer from Calgary, published 40 scientific papers in the Canadian Entomologist on taxonomy of Lepidoptera and worked with the British Museum, the Smithsonian Institute, as well as Fletcher, who was a Lepidopterist. Two other members from Blackfalds, A. D. Gregson and his brother, P. Gregson, who grew up near the Rothschild estate in England, collected fleas, including many new species, for the Rothschild's famous flea collection and for the British Museum. The Gregsons, who labelled all their collections "Red Deer", collected so many fleas that Red Deer became known as the "Flea Capital" of North America.

In 1903, among the insects reported by the Society in Alberta were horse bots, ox warbles, Colorado potato beetles, diamond backed moths, onion and turnip maggots, red backed cutworms, winter moths, and willow and poplar beetles.

Insects caused severe problems in the early 1900's and by 1913, a professional entomologist was appointed. Over the years, there have been five federal government institutions that have been involved in the study of insects in Alberta. I would like to discuss each group separately and indicate the main staff members, the insects studied, and the areas of research.

Years	Latest Name	Institution	No. Scientists
1913-	Crop Insect Section	Research Station Agriculture Canada Lethbridge, Alberta	49
1925-	Forage Crops Section (Apiculture)	Research Station Agriculture Canada Beaverlodge, Alberta	7
1942-56	Entomology Section	Suffield Experimental Station Defence Research Board Department of National Defence Ralston, Alberta	10
1947-	Animal Parasitology Section	Research Station Agriculture Canada Lethbridge, Alberta	18
1948-	Entomology Section	Northern Forest Research Centre Forest Research Service Agriculture Canada Edmonton, Alberta	21

Crop Insect Section - Lethbridge Research Station

First Phase - 1913 to 1944.--In 1911, reports of cutworm damage to grain crops were being sent to the Dominion Entomologist, C. G. Hewitt, who succeeded Fletcher in 1909. In 1912, over 16,000 ha of grain were destroyed by cutworms and farmers requested help from the Department of Agriculture. In 1913, Hewitt hired Edgar H. Strickland to establish a western Dominion Entomological Laboratory at the Dominion Experiment Farm in Lethbridge. Strickland was to determine the entomological problems in Alberta, solve the cutworm problem on grain and as many other problems as possible, and do all the necessary extension work. In the fall, he was to return to Ottawa for the winter.

Strickland's laboratory was part of a machine shed on the Experimental Farm. For equipment he had a binocular microscope, two insect nets, some note books, 1000 pins, six Schmitt boxes, and authorization to purchase Paris Green, sealers, and materials to construct cages. At first, Strickland travelled by train and horse and buggy. He asked for a car but the request was reduced to a motorcycle. This was discussed thoroughly in the House of Commons, and with the opposition consenting, Strickland finally got a motorcycle.

Strickland's knowledge of cutworms was limited so he was advised to see the farmer "who was the world famous moth specialist". Wolley-Dod gave him 200 pages of his reprints on Lepidoptera and much help. Strickland also met W. H. Tams, Wolley-Dod's "farm hand", whose farm work consisted partly of making collections of moths and butterflies, mounting lepidopteran genitalia, and doing photography for his employer. Wolley-Dod enlisted in the army in World War I and Tams returned to England where he was appointed Curator of Lepidoptera at the British Museum with no further training other than what he had received from Wolley-Dod.

In 1915, Strickland was given a motorcycle with a sidecar, and a travel and equipment budget of $990 for the summer. He spent $525 of this money on a two-room laboratory which was built at the Experimental Farm. This building, with the addition of two rooms, a greenhouse and a basement, was the only laboratory facility available for the Field Crops Insect Section until 1949 when the Science Service Laboratories Building was completed.

Strickland joined the army in 1916, but returned to the Department of Agriculture in 1919. In that year, both cutworms and grasshoppers were causing problems for farmers in Alberta but Ottawa thought that Strickland should work in the East on stored grain insects. His future was solved by having him work in winter in Ottawa on stored grain problems and in summer on grasshoppers, cutworms and other insects in Alberta. Strickland's transportation improved greatly in 1919 when he was given a Ford touring car with demountable rims and a sloping windscreen.

During the summer of 1919, the grasshopper control program carried on by Strickland cost $15,659.76 for the bait ingredients of 9414 lbs of arsenic, 5350 lbs of Paris Green (copper acetoarsenite), 2106 sacks of bran, 56 cases of lemons, 350 gallons of molasses, and 600 lbs of salt.

In 1921, H. L. Seamans came to work with Strickland. In 1922, Strickland left to become Professor of Entomology at the University of Alberta. In 1922, Walter Carter joined the staff to work on cutworms and forage insects as a Junior Entomologist. Carter later went to Hawaii and became known for his work on insect transmission of plant diseases. Carter was replaced by H. Gray.

The Northwest International Committee on Farm Pests was formed in April 1921 by scientists in the three Prairie Provinces and the northern States of Minnesota, North Dakota, and Montana. This organization became the International Great Plains Conference of Entomologists in 1933 and continued to exist until 1967. The organization was formed to obtain cooperation between the Prairie Provinces and the adjacent States, to develop legislation to force control of pests, and to exchange information on population levels, biology, and control of problem insects.

The offices of the entomologists were moved to the 4th floor of the Post Office in Lethbridge in 1924 but the laboratory facilities remained at the Experimental Farm. The offices were not readily accessible after hours and a local Post Office regulation forbade bringing insect material into the offices. Thus, the facilities were not very satisfactory for entomological research.

Between 1928 and 1930, the staff increased to five with the addition of G. F. Manson, C. W. Farstad, and R. W. Salt who were hired to work on wheatstem sawfly, grasshoppers, and forage crops insects. Gray was transferred to Ottawa in 1931 to head the Garden and Forage Insect Unit for Canada.

During 1932-35, R. M. White and E. MacMillan were transferred from Manitoba and Saskatchewan to work in Alberta on grasshoppers and cutworms, and L. A. Jacobson, C. L. Neilson, and P. J. Rock were hired to work on Say's grain bug, wheat stem sawfly, and grasshoppers. MacMillan died while taking graduate studies. R. H. Painter was transferred from Manitoba to work with White on grasshopper studies in 1938 and to do extension work. He was put in charge of the warble fly control program for Canada in 1942. H. Hurtig joined the staff in 1940 to work on garden and special crop insects.

The Dominion Department of Agriculture was reorganized into four services in 1937. One of the Services was Science Service with Entomology as one of its five divisions.

Seaman's staff needed more space, but with the Depression and then World War II, money was not available. However, the scientists were allowed to dig a basement under the laboratory "if they could do it at little or no cost to the government". R. H. Painter obtained a horse and a scoop and with the help of the other scientists dug out the basement. R. W. Salt was allowed a few dollars to wall off part of the basement for a laboratory for his low-temperature studies of insects.

In 1943-44, N. D. Holmes and W. A. Nelson joined the staff to work on the wheatstem sawfly which had become the major insect problem in the prairie area of Canada in the late thirties. During the war (1939-45), Holmes, Hurtig, and Neilson enlisted in the army, Rock returned to farming, and Salt replaced Strickland at the University of Alberta from 1940-42. Seamans was transferred to Ottawa as Head of the Field Crops Insect Unit for Canada in 1944, and was replaced by Manson as the Head of the Laboratory.

Serious pale western cutworm outbreaks had occurred and the recommendations from Ottawa to cultivate out weeds before the moth flight and spread bait had not worked. Strickland found that the pale western cutworm laid its eggs on the soil, not on the leaves, as some other cutworms did. He also noted that the cutworms fed almost entirely below ground. Strickland studied cutworm parasites, tested baits, developed a trap for adults, and devised a chart to show when it was safe to reseed. In 1923, a fungus disease was tested for cutworm control. Limited success was achieved in controlling cutworms by trapping with lights, baits, and sticky traps but these methods gave a good indication of the population levels of adults in summmer and fall. Nutritional value of various plants for the cutworm was studied, as well as the effect of temperature on diapause. Seamans developed methods of forecasting outbreaks, and cultural methods of control for the cutworm. He suggested that farmers stay off summerfallow during the cutworm's egglaying period of late summer and early fall so that the soil could form a crust. The cutworms could not penetrate the crust and lay their eggs. For his research contribution, Seamans was awarded the Gold Medal of the Professional Institute of the Public Service of Canada.

In 1927, a project for the control of the wheat stem sawfly was started. The sawfly, which originally inhabited a variety of native grass in western North America, was first found to be damaging wheat near Moose Jaw, Saskatchewan in 1898 and in Alberta in 1920. By 1925, it was a problem in Alberta and by 1938, it was the most serious insect problem in the Prairie Provinces and the adjacent States. Between 1938 and 1948, annual losses in the Canadian Prairies caused by the sawfly amounted to 508,000 metric tons of wheat, with a high loss of 635,000 metric tons in 1944. Early control methods were to plant headlands and ditches to grass to serve as a trap for eggs, as the sawfly was a poor flier and laid most eggs on the edges of fields. The grass was then cut, dried, baled and fed to cattle along with the millions of sawfly larvae. Farmers were advised to deep plough the grain stubble to bury the sawfly larvae in the overwintering stubble. They were also advised to alternate wheat and oats, as oats was an unsuitable host for the insect.

Dry weather and high wind conditions caused soil on ploughed fields to erode and soil drifting to occur. Cultivators and blades were recommended to preserve the stubble and prevent the soil from blowing away. Strip-cropping with alternate crop and summerfallow strips, each about 100 metres wide across the field were also used to prevent soil movement. The blading did not kill the sawfly larvae in the stubble and the strip-cropping allowed the sawfly to infest 100% of the crop. Generally, sawflies only infested the margin of fields but with narrow strips the whole field became infested. Trap cropping and swathing or cutting the crop when it was on the "green side" kept stems from being cut by the insect and reduced sawfly damage.

Early workers noted that solid-stemmed durum wheats were less severely cut by sawflies than bread wheats. H. J. Kemp of Swift Current found that a solid-stemmed New Zealand bread wheat, S-615 was also highly resistant to the sawfly but was susceptible to rust. He crossed it with rust-resistant Apex from the University of Saskatchewan. This cross led to the eventual development of a rust- and sawfly-resistant variety of wheat by Swift Current plant breeder A. W. Platt and Lethbridge entomologist C. W. Farstad. The Entomological Society of Canada Medal for Outstanding Achievement in Canadian Entomology was awarded to C. W. Farstad in 1966 for his research on the wheatstem sawfly.

Grasshoppers were present on the prairies of Alberta when the farmers first planted their crops. A bad outbreak occurred across the prairies from 1898 to 1904 and again in 1919. In that year, 650,000 ha were infested in southern Alberta farming areas and another 130,000 ha on Indian Reserves. Control of the grasshoppers depended on poison baits spread by farmers. The most effective bait was that known as the Criddle mixture consisting of one part Paris Green, 2 parts salt, 35 to 40 parts horse dung and enough water to make the mixture soft. The mixture attracted grasshoppers for at least 40 feet. In 1921, Strickland and Seamans pressured the Alberta Government into passing the Pest Control Act, which later became the Agriculture Pest Act. This was passed in order to help combat the grasshopper outbreak.

By 1922, the grasshopper problem was considered severe enough that the Assistant Deputy Minister of Agriculture for Alberta was put in charge of the control campaign and Strickland was in charge of the field work. In June 1922, Lethbridge had the Rotarian Grasshopper Campaign with the Lethbridge Rotary Club, the Board of Trade, and other Service Clubs spreading bait on grasshopper breeding grounds in and near Lethbridge. In 1933, an Entomological Branch Committee was set up to assess grasshopper research. They recommended "that the grasshopper program concentrate on the principles underlying the grasshopper outbreaks".

During the 1931-44 grasshopper outbreak, farmers annually spread an average of 6.4 million kg (wet weight) of bait in Alberta. To ensure that adequate amounts of bait would be available, White and his associates issued annual forecasts of populations. These forecasts were first started in Alberta in 1932 and were standardized with those of the other Prairie Provinces. They were derived from surveys of populations of mature grasshoppers as they began to oviposit, modified by a later, more limited survey of the eggs laid.

In the early years, many different baits were tested against grasshoppers. In 1934, the use of airplanes was investigated as a means of spreading poison bait

more quickly and efficiently than ground rigs. It was concluded that airplanes were not mechanically reliable. The entomophagus pathogen Entomophthora (=Empusa) grylli was also found and tested but epidemics of the disease could not be established. Studies were also done on the relation of soil pH to the selection of egg beds by grasshoppers, and the effects of defoliation by grasshoppers on grain yield.

Another insect that was present in tremendous numbers was the beet webworm. This insect was expected to be a more severe problem than cutworms or grasshoppers. In 1920, Strickland reported "vast numbers of webworms suddenly appearing from Lacombe to the United States border and across the province. The migrating larvae were so numerous on railway tracks that they stopped two trains between Lethbridge and Calgary, and motorists had to use chains to drive on the larvae-covered roads near High River". The larvae damaged gardens and destroyed broad-leaved crops but cleaned all the broad-leaved weeds out of grain crops. The next year, the insect was no problem but it has caused problems to sugarbeets sporadically since 1925.

Other studies included control and life history studies of the Say's grain bug, a new pest of wheat in the thirties, by Jacobson; cold hardiness and winter survival of insects by Salt, and pollination of forages by Carter, Gray, and Salt. The pollination research indicated that honey bees were poor pollinators of alfalfa in Alberta because they did not trip the alfalfa blossoms. Bumble bees were studied in artificial domiciles and native leafcutter bees were identified. The tongue lengths of pollinators were correlated with length of corolla tube of the alfalfa, and bumble and leafcutter bees were considered to be important for alfalfa pollination.

Besides the major pests, a number of other problem species were found in Alberta prior to 1945. Mites on wheat in 1913, red turnip beetle in 1914, army cutworm in 1915, Hessian fly on wheat in 1916, flea beetles, wireworms, woolly bears on crops and Rocky Mountain Wood ticks on animals in 1921, alfalfa and clover seed chalcids in 1923, tipulid larvae on alfalfa in 1925, false chinch bugs, diamond back moths, and fall cankerworm in 1924, clover thrips, oat thrips, and bertha armyworm in 1927, currant fruit fly, potato psyllid, and sugarbeet root maggot in 1933, Say's grain bug in 1934, pea aphid on peas in 1940, clover mites in 1942, grape leaf hopper, sugar beet root aphid, sweet clover weevil in 1943, and western wheat aphid in 1944.

During these 31 years, there were lots of insect problems, very little equipment and limited laboratory facilities, but travel funds seemed to be adequate to conduct some excellent field studies. The scientists spent the spring, summer, and fall in the field. Roads were poor but travel was extensive. The scientists were working almost entirely on insects of economic importance. Most of the winter was spent summarizing data and doing extension. There were some summer students but no technicians so the scientists helped plant, hoe, weed, and harvest plots, and made most of the observations on the insects. There were detailed fortnightly, technical, and annual reports, and each scientist was expected to do considerable extension. Little encouragement was given to the publication of scientific papers which had to be approved in Ottawa before publication. The emphasis was almost entirely on solving major insect problems and having the solutions used by the farmer as soon as possible.

Postwar Period - 1945-1964.--The early entomologists had been very successful in reducing damage by insects on the Prairies and farmers were informed whenever new control information was available. Thus, the government, the farmers, and the general public supported the entomologists. In the early forties, J. M. Swaine, who had been appointed the Director of Science Service in 1937, asked Seamans and his staff to start thinking about a new laboratory and increased staff after the war to absorb returning war veterans and provide public works programs.

In 1945, G. A. Hobbs was hired to do research on pests and pollinators of forages. Holmes, Neilson, and Hurtig returned from military service but all left shortly to start graduate studies. K. W. Neatby by now had become the Director of Science Service and he wanted improved facilities at Lethbridge, so in 1946 he encouraged the staff at Lethbridge to start seriously planning a new laboratory building.

In 1946, P. E. Blakeley, A. J. McGinnis, and D. Barnes were hired to work on the wheatstem sawfly, W. W. A. Stewart to work with Painter on warble flies, and L. E. Putman was transferred from Manitoba to work on grasshoppers. In 1947, B. Fortin was transferred from Quebec to work on insect physiology, G. E. Swailes was hired to work on garden, greenhouse, and special crop insects, and W. Chefurka was transferred from the Manitoba Laboratory to work on grasshoppers. In 1948, R. I. Larson and M. R. Mackay were hired to work on the wheatstem sawfly, and A. M. Harper to work on special crop insects and help with the grasshopper survey. In the same year, White retired, Manson was transferred to Ontario to Head the Chatham Laboratory, and was replaced by Farstad as Head of Entomology at Lethbridge.

In 1948, after Hurtig obtained his Ph.D., he was seconded to Suffield and although he was on the staff of the Field Crop Insect Laboratory he also became the Head of Entomology for Defense Research Board at the Suffield Experimental Station. Hurtig worked mainly on chemcial control of insects and insect dispersal of animal diseases.

In 1949, C. E. Lilly and I. S. Lindsay were hired to work on the pale western cutworm, and D. S. Smith and F. E. Northcott were transferred from the Brandon Laboratory to work on grasshoppers. In 1950, N. S. Church was hired to work on sawfly physiology, M. D. MacDonald was hired to work on forage insects, and J. A. Mutchmor to work on grasshoppers. In 1952, L. K. Peterson was hired to work on sawfly, and in 1953, S. McDonald was hired to do insecticide studies.

During the 8-year period from 1945 to 1953, 21 new scientists were hired and 14 scientists left. Neatby not only wanted better laboratory facilities, he also wanted a well-educated staff at the Science Service Laboratories in Canada, so he encouraged new scientists who were mainly hired with Bachelor's degrees to continue their education. In the early postwar period, there were more scientists with Bachelor degrees than Doctorates. Scientists in entomology with only Bachelor degrees returned to university and obtained 26 advanced degrees from 16 different universities in the next few years. As there were few scholarships or assistantships, scientists who returned to university paid their own way from savings, received half pay from the Government, or if they were veterans, the Department of Veterans Affairs (DVA) Re-establishment Credit Program paid for university fees, books, and a small living allowance.

Initially, scientists were allowed education leave only during the winter and had to return to their jobs during the summer. Because universities were overcrowded and often had very few research facilities, many scientists took courses for their advanced degrees at a university and did their thesis and research after work and on weekends after they had returned to their jobs. As more scientists completed advanced degrees those that applied for leave later were allowed to stay at the university to complete their degrees.

This was a very interesting and enthusiastic time at the Science Service Laboratory as part of the staff was always returning from educational leave with new ideas, information, and techniques. The contacts with other graduate students and professors, and the interchange of ideas among the different disciplines now associated with entomology, had a profound and beneficial effect on all the staff.

During this period when scientists were improving their education, a policy was being developed to provide them with some full-time technical help rather than only summer students. The first technician in the Field Crops Entomology Laboratory was hired in 1946 and several others were hired after the Science Service Building had been completed. Several vacant scientific positions were converted to technical positions during this period but it was not until 1973 that all scientists in the Section had full-time technicians.

In 1947, it was decided that there should be a Veterinary Livestock Research Laboratory at Lethbridge. Painter was asked to head the new Laboratory and to start arranging for a building and hiring staff. W. W. Stewart left the Field Crops Insect Laboratory in 1947 and Nelson in 1948 to join Painter's staff.

Barnes left the Laboratory in 1948 to take post-graduate education and resigned; Neilson joined the B.C. government as an entomologist. In 1951, Chefurka returned to University and then was transferred to the London Laboratory. In 1952, MacKay completed her Masters degree and resigned to get married, Mutchmor resigned to take post-graduate studies, Northcott resigned to get married, and Fortin transferred to the St. Jean Laboratory. In 1953, Lindsay transferred to the Suffield Experimental Station at Ralston and Putman transferred to the Saskatoon Laboratory. In 1958, Farstad moved to Ottawa to become Head of Plant Protection for Canada and Holmes became Head of the Section.

In 1950, the staff was at the highest level it ever reached, 21 scientists, and of these scientists 4 were women. All of the women scientists obtained Masters degrees and one obtained a Ph.D. By 1953, three of the women had resigned, and in 1964, Larson was transferred to the Plant Science Section. No women scientists worked in the Field Crops Insect Section prior to this postwar period and none have worked in the Section since 1964. In the postwar period the number of full-time agricultural entomologists in the Canadian Department of Agriculture increased to 350 from the 1939 level of 140.

Several of the scientists were spending a good part of their time doing extension work in the early fifties which was seriously affecting their research. It was decided that an Information Officer was needed and Blakeley relinquished his research responsibilities to become Information Officer for the Science Service Laboratory at Lethbridge. In 1964, the Chemistry Section was disbanded and R. Kasting was transferred to the Field Crops Section as he had been working for several years with McGinnis on insect nutrition.

At the same time as the staff was being increased and qualifications improved, Neatby and Seamans in Ottawa and the staff in Lethbridge were trying to obtain better laboratory facilities. In the winter of 1946-47, many hours were spent developing plans for a new laboratory building. Initially, plans involved adequate space for studying only entomology but Neatby, who was a great exponent of cooperative research, decided the new building should house a group of Science Service Laboratories. At that time, Science Service had no architects in the organization and the entomologists at Lethbrige did all the planning of the building.

A Building Committee was set up with Jacobson as chairman and Manson, Farstad, Salt, and Painter as members of the Committee. The Committee needed two sets of buildings, one for Painter's Livestock Insect Laboratory, and one for the main Science Service Laboratory. The Committee was able to get the hospital and some other buildings from Crown Assets who were disposing of the buildings at the Royal Canadian Air Force No. 8 Bombing School just south of Lethbridge. The buildings were measured, laboratories planned, and land was obtained for the buildings and an experimental area from the Experimental Farm. The sod was turned in March 1947 for the new Laboratory.

Plans, specifications, contracts, and priorities were set by the entomologist-contractors. Jacobson, who was in charge, hired carpenters, plumbers, electricians, painters, and laborers, and supervised the building. Salt, in conjunction with W. H. Cook, Director of the Applied Biology Division of NRC, drew up plans for a series of controlled temperature rooms.

By 1948, the building had been moved and a boiler had been obtained from Crown Assets at the Bowden RCAF Station. During the following year, the cereal breeders, plant pathologists, a chemist, a plant physiologist, a librarian, the administration, and eventually the entomologists moved. As no money was available for moving, the younger entomologists, such as Harper, Holmes, and Swailes, did the job with half-ton trucks that Jacobson had obtained for construction of the building. The younger scientists also helped dig drainage ditches and acted as part-time laborers. The total Science Service complex of the Science Service Laboratories Building, six suites and five houses, and the Livestock Insect Laboratory and its six suites, cost less than $500,000.

With the completion of the Science Service Laboratory in May 1949, the Dominion Entomological Laboratory ceased to exist. It became the Field Crop Insect Section of the Science Service Laboratory. Dr. W. C. Broadfoot, a plant pathologist from Ottawa, became the first Director of the new Laboratory.

Other changes were also occurring. Library facilities were being developed, greenhouses were built, money was available for equipment, scientists were returning from post-graduate studies with the latest training, statistical analyses were being used, teams of scientists had been gathered to work on the major problems of cutworms, grasshoppers, and the wheatstem sawfly. For the first time, most of the entomologists were in close contact with plant pathologists, plant physiologists, chemists, plant breeders, horticulturalists, soil specialists, and animal scientists.

After facilities and trained staff were developed, publication of scientific papers was emphasized and a policy close to "publish or perish" developed. Neatby's attitude was that research was not complete until it had been

published, and the act of publishing made one look at the research critically. Neatby also did away with fortnightly and technical reports and shortened the annual report to one to two pages per scientist. Both the newer scientists and those who had been on staff for some time increased the number of scientific and extension publications, and scientific productivity as measured by numbers of publications greatly increased. Neatby tried to visit every scientist every year and discuss their research with them. He also set up a 5-year review system for all projects. Once the project had been set up and approved, the scientist was given a lot of latitude as to how he solved the research problem. No project was to be for more than five years before it was reviewed and at that time it was to be renewed or discontinued.

In 1959, Neatby as Director of Science Service and C. H. Goulden, Director of the Experimental Farm Service of the Department of Agriculture, decided the two organizations should be amalgamated into a new organization--the Research Branch. In September 1959, just before amalgamation, Neatby, who was to head the new organization, died suddenly of a brain tumor and C. H. Goulden became the Director. Dr. T. H. Anstey became the Director of the Lethbridge Research Station. The Experimental Farm (established in 1906) and the Science Service Laboratory ceased to exist. Since the amalgamation 27 years ago, only nine entomologists and one chemist have been hired by the Field Crops Entomology Section, and two of the entomologists have left. All but one of the entomologists present at the time of amalgamation have retired.

During the period from 1945-1965, the sawfly problem was solved by the development of the sawfly-resistant wheats, Rescue in 1946 and Chinook in 1952 by Platt, and Cypress in 1962 by H. McKenzie. The sawfly was not eradicated but its damage was reduced to insignificant levels and the sawfly became a minor pest. About 1960, the populations of the insect were so low that it became necessary to establish a nursery on government pasture land so that sawfly populations could be maintained for testing lines of sawfly-resistant wheat and for use in studies of the insect. Although the first resistant variety was developed in 1946, resistant varieties are still giving satisfactory control of this insect 39 years later.

Because the sawfly had been such a problem, studies of this insect continued. Larson and MacDonald studied inheritance of sawfly resistance in wheat. D. W. A. Roberts, a plant physiologist with Science Service at Lethbridge, investigated the physiology of wheats in relation to resistance to sawfly. McGinnis and Science Service chemists R. Kasting and L. E. Lopetecki studied the nutrition of the wheatstem sawfly. Salt and Church assessed cold hardiness and hormone activity in the insect. Mrs. F. R. Harper (nee A. M. Wall) a cereal breeder, studied sex ratio in sawfly populations, and MacKay studied the cytology of the sawfly. Farstad, Holmes and Peterson studied tillage, effects of weather, and population dynamics. Nelson, Neilson, and Holmes studied parasitism. At one time, 21 scientists throughout the Prairies were studying the wheatstem sawfly.

The cutworm research in the forties was reduced because Jacobson, who was in charge of the project, was concentrating mainly on the construction of the Science Service Laboratories Building. In the fifties, Jacobson and Blakeley started publishing their studies of cutworms dealing with life histories, starvation, development, oviposition, and temperature and moisture effects of the pale western cutworm, the redbacked cutworm, and the armyworm. Kasting and McGinnis studied the nutrition of the pale western cutworm.

The research on grasshoppers was mainly in two areas during this period. Smith, Northcott, and Mutchmor studied nutrition, effect of nitrogen and phosphorus in the food, feeding habits, food preferences, and starvation on the grasshoppers. Putman and Hurtig tested insecticides. By 1948, Putman had shown that grasshoppers could be readily controlled by some of the newer chlorinated hydrocarbons and a Cooperative Grasshopper Conference in Saskatoon decided sprays should be used in place of poison baits. During the period, systematic grasshopper surveys were carried out by R. M. White (1932-46), L. E. Putman (1947-49), and by D. S. Smith from 1949 onward.

In 1949, the members of the Field Crops Insect Section, the Entomology Section at the Suffield Experimental Station, and staff from Alberta Agriculture conducted the first large-scale aerial spraying experiment for insects in Alberta. Hurtig was in charge and was assisted by Putman. Because Hurtig was the Head of Entomology at Suffield, he was able to get the Air Force at Suffield to provide a DC3 plane and the army to assist in a study of droplet size and dispersal and to help generally with the experiment. The whole Field Crops Insect Section was on the site to assess grasshopper and non-target insect populations before the spraying and to assess populations at various post-spray periods. The whole experiment went extremely well until Franklin gulls moved into the area in large numbers and ate most of the insects on the check plots as well as the treated ones part way through the experiment. Although the experiment was not entirely successful it gave much information on large-scale aerial spraying.

From 1957 to 1959, R. Baird was temporarily transferred to Lethbridge, from the Biological Control Laboratory, Belleville, Ontario, to study control of grasshoppers by disease organisms, especially Entomophora grylli.

Very little research on special crop and garden insects had been published at the Laboratory prior to 1950 because the work covered so many insects and such a broad area. Harper and Swailes, who were working in this area, decided to concentrate on one or two insects that were economic problems. Swailes studied the influence of soil and moisture on the beet webworm, and on the biology, oviposition, reproduction, and effect of temperature on the insect. He also worked on the control by sterilization, plant resistance, and chemicals of the cabbage maggot. Control of root maggots by the use of organochlorine insecticides increased the area where cabbage and turnips could be readily grown.

Harper conducted research on the sugarbeet root aphid which had become the limiting factor for sugarbeet production in 1949 with some fields yielding as little as 12 tonnes per hectare which was well below the cost of production. The aphid lived part time on poplar trees and part time on sugar beets. A number of predators were found to be feeding on the aphid on both hosts and helping to keep it under control. Soil insecticides were tested but they reduced predator populations so the number of aphids in insecticide treated plots was equal to or greater than in untreated plots in fall. Several sugar beet varieties were tested and two showed resistance to the sugar beet aphid. All heavily infested sugarbeet fields were in the heavier soil areas and many were being inadequately irrigated. Several recommendations were made: plant sugarbeets early so they become well established before they become infested, irrigate the beets early and frequently during the growing season, keep the fertility level high so beets grow vigorously, do not treat soil with

insecticides, and accept a low level of aphids as normal and as a source of food for the predators. These recommendations have been followed and have worked satisfactorily since 1955, yields have increased over the years, the predator population has remained high, and the sugar beet root aphid has not been a problem.

In 1956, the sugarbeet root maggot became the limiting factor to sugarbeet production in the sandy soil areas of southern Alberta. Harper and Lilly tested a wide range of control measures. There were no important predators or parasites of the insect, and although a large number of sugarbeet varieties were tested, none showed resistance. Insecticides were tested and heptachlor-impregnated fertilizer at one pound per acre gave excellent control with no residues when properly placed in the drill row. A seed treatment at one ounce per acre was also effective but farmers preferred the impregnated fertilizer treatment and would not change. In 1960, the oxygen analogue of heptachlor, heptachor epoxide, which was very stable and which no one had analyzed for, was found in sugarbeet pulp at actionable levels and one million dollars of beet pulp was considered unsafe. The registration for heptachlor on sugarbeets was withdrawn and the beet pulp was diluted with that from following crops to reduce it to well below actionable levels. Thorough surveys showed that sugarbeet root maggot populations were low and a recommendation was made not to treat sugarbeets for maggots unless damage had been apparant the previous year. Two other insecticides had been tested and shown to be effective for control of the maggot if populations had been high. All the chemical control work for the sugarbeet root maggot was done in conjunction with Dr. P. Bergen of the Canadian Sugar Factories, and all the extension work was done by the Sugar Company Fieldmen.

In 1961, the sugarbeet nematode was first found near Barnwell. Harper, Lilly, and E. J. Hawn, a plant pathologist at the Research Station, worked with sugar company officials on the problem. The infested field was ploughed and thoroughly treated with a soil fumigant, taken out of production, and planted to nonhost crops for several years. An intensive survey was carried out and 10 more lightly infested fields were found. With the cooperation of the Sugarbeet Growers Association and the Canadian Sugar Factory a 4-year rotation was immediately instituted with no nematode hosts, such as crucifers, to be grown in the rotation. The rotation has worked to keep the nematode populations over the whole sugarbeet growing area of Alberta below economic levels for almost 25 years and only one field other than the initial one has been treated with a fumigant and taken out of production during that time.

The beet leaf miner heavily infested sugarbeets in 1959. The most severe infestation occurred in August and early September and the damage was mainly on the older leaves. Although many farmers wanted to spray for the infestation it was recommended that they not spray as the older leaves were not very active photosynthetically because of shading by the newer leaves, the leaf miner larvae were parasitized, and many were being killed by disease. The yield of sugar beets was normal without spraying. Although a small population of beet leaf miner has been present in sugarbeets each year, they have been kept under control naturally by disease and parasites. Detailed studies on the effect of defoliation and stand reduction on sugarbeet yields have shown that the beets can withstand considerable damage without loss of yield.

In 1956, the first major extension publication on sugarbeet insects, and of insects on crops used in rotations with sugar beets, was published by the Field Crop Insect Section in the Canadian Sugar Factories Bulletin "Silver Sunshine". Five thousand copies of the bulletin were distributed; one was sent to every sugarbeet grower and many extension workers in Western Canada. This extension publication almost completely eliminated the need for extension work on sugarbeet insects in Western Canada by federal government scientists.

During the fifties, Hobbs and Lilly published on honeybees, bumble bees, and leafcutter bees as pollinators of alfalfa and showed that honeybees were poor pollinators. Artificial domiciles were built and used in the studies of the ecology of many species of bumble bees. Studies were also made of insect pests and predators in relation to alfalfa seed production. The biology and control of the superb plant bug was studied and it was shown that spring burning could be very effective for keeping the bug under control without the use of insecticides. In 1956, the alfalfa weevil was found in Alberta and preliminary studies of distribution and life history were started. Hobbs and his coworkers attempted to protect native bees in their nesting sites and increase the number of both bumble and leafcutter bees in the field for pollination of alfalfa, but with little success. In Washington, alfalfa seed producers were using alkali bees successfully for pollination but Hobbs was unable to establish them in Alberta. In Utah, scientists had found that an imported gregarious leafcutter bee, Megachile rotandata, would live very well in soda straws and were rearing them artifically in large numbers for pollination of alfalfa. By 1962, Hobbs had imported the bee to Canada and was able to improve rearing by providing shelters against the weather and by using grooved boards to make it easier to control parasites and predators of the bees. He published an excellent extension bulletin that was well received by seed producers in Canada and foreign countries. The methods he recommended worked well and alfalfa seed could be readily produced and excess bees could be sold at a profit. A multi-million dollar alfalfa seed and leafcutter bee industry developed in Western Canada. Hobbs won a special Merit Award from the Public Service of Canada for this contribution.

In 1956, the European corn borer was found in one market garden in Medicine Hat by Harper and Lilly. A detailed survey did not reveal any other infestations and as the irrigated area was considered to be an ecological island surrounded by a large area of grain and grassland, a very thorough eradication program was initiated. With the aid of Alberta Agriculture, especially J. Gurba, the pest control supervisor; J. Anderson, the Medicine Hat District Agriculturalist; R. Stogryn, of Federal Plant Protection; and the City of Medicine Hat Sanitation Department, all the corn stubble was ploughed deeply, burned, or bagged and destroyed. The area was checked for corn borers regularly and no corn borers were found for 25 years.

Wireworms had been a problem on the Prairies, especially on newly broken land, for many years. Tests with the organochlorine insecticides were conducted at the Saskatoon Research Station and by Lilly in Alberta. Seed treatments of cereals for wireworms greatly increased grain production and treatments of potatoes increased the marketability of the crop in Alberta. With new insecticide treatments, wireworms have been reduced to a minor problem in Alberta for a number of years.

Other insects were also present: flea beetles attacked beets and mustard, Lygus and Adelphocoris damaged alfalfa, Irbisia sp. and Capsus sp. damaged grass and grain, the corn leaf aphid destroyed an estimated 109,000 ha of barley in 1956, beet webworms, root maggots, sweet clover weevils, clover leaf weevils, army cutworms, and woolly bears also caused crop damage. Subterranean termites were found damaging two houses in Medicine Hat.

During this time, very effective insecticides became available and many insects could be readily controlled for the first time. Derris, aluminium fluosilicate, nicotine, pyrethrum, paris green, winter oils, and lead arsenate were replaced by newer chlorinated hydrocarbon insecticides such as toxaphene, DDT, aldrin, dieldrin, chlorodane and endrin. Hurtig was the first full-time insecticide specialist in the Section and McDonald was the second. McDonald tested many candidate insecticides, especially chlorinated hydrocarbons.

In 1962, the National Committee on Pesticide Use in Agriculture was organized, as well as the Western Committee on Crop Pesticides and the Western Committee on Livestock Pesticides. These latter two committees provided uniform, effective, and safe recommendations on insect controls for the Prairie Provinces and eventually all of Western Canada.

Modern Times - 1965-1985.--During this period, the number of scientists decreased from 13 to seven in 1975 but increased to nine by 1982. This was the same number of scientists that had been employed in Field Crops Entomology 45 years earlier, and less than half as many as were present in 1950. Nearly all the scientists hired during the forties and fifties retired or moved during the last 20 years.

In the late forties, fifties, and early sixties, the organochlorine insecticides that were widely used were effective against a wide range of insects, they were cheap, and they had reasonably low mammalian toxicity. However, they were persistent and produced long-lasting residues in the environment. They were replaced by organophosphate, carbamate, and synthetic pyrethroid insecticides that were more expensive, less effective, or had higher acute mammalian toxicity. However, most of these newer insecticides were much less persistent than the organochlorines and therefore did not cause long term contamination.

W. A. Charnetski was hired in 1965, D. L. Struble in 1968, and B. D. Hill in 1978 to study insecticide residues. Struble, a chemist, was also to study other aspects of insect chemistry. Struble was the first scientist hired in the Crop Entomology Section with a Ph.D. All other scientists with doctorates and many with masters degrees had completed their education after joining the Section.

In 1966, McGinnis left to become the Head of the Entomology Section at the Winnipeg Research Station and Peterson left to become Alberta Provincial Entomologist. Salt retired in 1970 and Jacobson in 1971. The cutworm research was continued by Swailes until 1980 when he retired, and then by J. R. Byers who transferred from Ottawa in 1981. Smith retired in 1973 and little grasshopper research was done until 1977 when J. M. Hardman was hired. Hardman transferred to the Kentville Research Station in 1982 and was replaced by D. L. Johnson in 1983 who continued work on grasshoppers and rangeland insects. In 1975, Kasting died and Hobbs retired. The work on pollination

was continued by K. W. Richards who was hired in 1976. Holmes retired in 1978 and was replaced by McDonald as Head of the Section. Schaber was hired in the same year to work on pests of seed alfalfa. Lilly retired in 1981 and the work on sugarbeet insects was continued by G. H. Whitfield who was hired in 1982. McDonald retired in 1983, Charnetski commenced studies on chemical control of insects, and Struble became Head of the Section.

Several major projects were terminated during the sixties and seventies. Nutritional studies of the pale western cutworm, the wheatstem sawfly, and grasshoppers were terminated with the retirement of Smith and the death of Kasting. Research on the wheatstem sawfly was terminated with the retirement of Holmes. Studies on the nature and causes of freezing and cold hardening in insects were terminated when Salt retired. Salt was awarded the Gold Medal of the Entomological Society of Canada in 1972 for his research contributions.

Grasshopper surveys have continued with the Research Station supervising the surveys and preparing the forecast maps, and provincial government employees carrying out the survey. Smith completed compilation of the long term survey data and initiated studies of rangeland insects before he retired in 1973. Hardman and Johnson have continued these studies with special emphasis on population dynamics. Johnson has also continued grasshopper control studies with chemicals and pathogens.

In the early sixties, Lilly initiated research on sex attractants in the Section. He and M. Jacobson of Beltsville, Maryland, found male sex attractants for both the sugarbeet wireworm and the common June beetle. Later, Lilly worked with Struble and isolated and tested a sex attractant of the beet webworm.

Cutworm research on biology, ecology, rearing, and population dynamics has been conducted by Jacobson, Swailes, and Byers. Synthetic phermones were developed and tested for Lepidoptera such as army, pale western, red backed, darksided, variegated, early, and clover cutworms by Struble and the above scientists. Most of the synthetic phermones were shown to be multicomponent attractants but some inhibitors of the attractants were also found.

In 1981, the European corn borer was found again by Lilly and Harper at Medicine Hat in 11 fields. The insect was extremely scarce in 9 of the fields but could be readily found in the other two. A detailed survey was made by Harper, Lilly, N. Collard of the Federal Plant Protection Section, Lethbridge; and U. Soehngen, of the Alberta Horticultural Research Station, Brooks. No other infestations were found. Attempts were made to start an eradication program but there was no support from the provincial government, the federal government, the corn growers, or the Corn Committee. Although an eradication program was not supported, considerable money was spent on monitoring adult and larval populations during the next four years. Meanwhile the insect slowly spread into all the corn-growing areas of Southern Alberta. By 1985, the insect had become so well established in some areas that fresh corn growers had to spray to control the pest before they could market their crop.

During the sixties and seventies large numbers of insecticides were tested by McDonald against Alberta insects in the laboratory with special emphasis on cutworms, grasshoppers, and the Colorado potato beetle. Insecticide residues of organochlorines were found by Charnetski to be widespread in the irrigated

soil in Alberta. Levels were low, and with the exception of DDT and chlorodane levels, were considered unimportant. Charnetski spent considerable time monitoring residue levels in water, and target and nontarget insects, for the blackfly control project on the Athabasca River. Residue studies in field crops have been continued by Hill with the main emphasis on the synthetic pyrethroids.

Aphids were studied during the late sixties and early seventies with emphasis on distribution, damage, disease transmission, and cytology. Over 145 species of aphids were collected in the province by Harper and G. Bradley of the Canadian Forest Service.

Since 1965, both seed and hay alfalfa production on irrigated land has become important and more research on the insect pests and pollinators of the crop has been required. Hobbs studied leafcutter bee management, designed special hives and shelters, evaluated polystyrene and wooden grooved boards, developed methods for reducing mold in hives, designed cell removers and tumblers, devised winter storage and incubation methods, selected a univoltine strain of leafcutter bee, and developed methods of controlling parasites and predators of the bees. After Hobbs retired, Richards continued the work with emphasis on control of parasites and predators of the leafcutter bee and refinements in management techniques. Integrated pest management for alfalfa seed production is being studied by Schaber who initiated a pest management program for seed producers in Alberta in 1978, which he managed for three years before turning it over to private industry. He is also studying the alfalfa weevil in detail, and the effect of burning of alfalfa in spring on insect populations.

Harper made detailed studies during the seventies and early eighties of the seasonal development of the pea aphid and its predators, parasites, and diseases. He also studied the effect of chemical control on the pests and beneficial insects in alfalfa hay fields. Although insecticides readily controlled the aphids on alfalfa, they seriously affected the other insects in the crop. Usually, aphid populations did not reach high levels until late July or early August. It was recommended that instead of spraying with insecticides the alfalfa be cut at this time as long as it was past the ten percent bloom stage. The aphid parasite, Aphidius smithi, which was found in one field in Alberta, was reared in large numbers and distributed throughout southern Alberta. The parasite along with other parasites, predators, and diseases, and the early cutting have kept the pea aphid under control with almost no use of insecticides for several years.

Verticillium wilt, the most serious disease of alfalfa, became a problem in Alberta in the early eighties. Spores of the disease organism were found by Harper, and H. C. Huang, a Plant Pathologist at the Research Station, to be carried on pest and predatory insects in alfalfa and also in the feces of leaf-chewing insects. It appeared that the integrated control would have to be modified to include greater use of insecticides. However, by 1985, a verticillium wilt resistant variety of alfalfa, Barrier, had been developed at the Research Station and insect transmission of the disease is not expected to be important in alfalfa hay production.

In 1981, the "Alberta Forage Manual", which contained a section on entomology, was produced as a cooperative venture of the Research Station and Alberta Agriculture. The publication has been extremely useful, is in its fourth

printing, and has been requested by nearly 25,000 agriculturalists since it was first published.

In 1976, a $24 million research building was completed for Research Station scientists and support staff, as well as about 150 personnel of Alberta Agriculture in southern Alberta. Facililties are excellent with an office and a laboratory for each scientist, insect rearing rooms, plant growth chambers, greenhouses, electron microscopes, mass spectrometers, an NMR, and computers. Nearly all the equipment necessary is available to do biological and chemical research in entomology and many other fields of agriculture.

Although the scientific staff in the Crop Insect Section is small, all scientists have doctoral degrees and each scientist has one or more technicians. Nearly all the technicians have taken post-secondary training at technicial schools, two have bachelors degrees, and two have Masters degrees. Until recently no outside funding could be accepted by Research Branch scientists but this has been changed, as chemical companies and Alberta Agriculture's Farming for the Future program have recently provided financial assistance for cutworm, grasshopper, sugarbeet insect, insecticide and pheromone research. The two major insect problems in 1985 were grasshoppers and cutworms, which were also the major problems in the early years of research in Alberta. Many other problems, however, have been solved and many of these without the use of insecticides or with limited use of insecticides. Most of the research over the years in the Section has been on the study of biology and integrated control with emphasis placed on finding the weakest part of the life cycle of the pest species and controlling the insect at that point.

Scientists in the Crop Insect Section - Lethbridge Research Station

	Degrees	Years
1913-1944		
Strickland, E. H.	B.Sc., M.Sc., D.Sc.	1913-22
Seamans, H. L.	B.Sc., M.Sc.	1921-44
Carter, W.	B.Sc.	1922-23
Gray, H.	B.Sc., M.Sc.	1923-31
Tinkham, E. R.	B.Sc.	1926-27
Manson, G. F.	B.Sc., M.Sc.	1928-48
Farstad, C. W.	B.Sc., M.Sc., Ph.D.	1929-58
Salt, R. W.	B.Sc., M.Sc., Ph.D.	1930-70
McMillan, E.	B.Sc., M.Sc.	1932-35
White, R. M.	B.Sc., M.Sc.	1932-48
Jacobson, L. A.	B.Sc., M.Sc.	1934-71
Neilson, C. L.	B.Sc., M.Sc.	1935-48
Rock, P. J.	B.Sc.	1935-43
Painter, R. H.	B.Sc., M.Sc.	1938-46
Hurtig, H.	B.Sc., Ph.D.	1941-56
Holmes, N. D.	B.Sc., M.Sc., Ph.D., LL.D.	1943-78
Nelson, W. A.	B.Sc., M.Sc., Ph.D.	1943-48

	Degrees	Years
1945-1964		
Hobbs, G. A.	B.S.A., M.Sc., Ph.D.	1945-75
Stewart, W. W. A.	B.A.	1946-47
Putman, L. E.	B.Sc., M.Sc.	1946-53
Blakeley, P. E.	B.Sc., M.Sc.	1946-58
McGinnis, A. J.	B.Sc., M.S., Ph.D.	1946-66
Barnes, D.	B.Sc.	1946-48
Swailes, G. E.	B.S.A., M.S., Ph.D.	1947-80
Fortin, B.	B.Sc., M.Sc.	1947-52
Chefurka, W.	B.Sc., M.S.	1947-51
Harper, A. M.	B.Sc., M.Sc., Ph.D.	1948-
MacKay, M. R.	B.Sc.	1948-52
Larson, R. I.	B.A., M.A., Ph.D., D.Sc.	1949-64
Lilly, C. E.	B.Sc., M.Sc.	1949-81
Lindsay, I. S.	B.Sc., M.Sc.	1949-53
Northcott, F. E.	B.Sc., M.Sc.	1949-52
Smith, D. S.	B.Sc., M.S., Ph.D.	1949-73
Church, N. S.	B.Sc., M.S., Ph.D.	1950-63
MacDonald, M. D.	B.Sc., Ph.D.	1950-64
Mutchmor, J. A.	B.Sc.	1950-52
Peterson, L. K.	B.Sc., M.S.	1951-66
McDonald, S.	B.Sc., M.Sc.	1953-83
Kasting, R.	B.Sc., M.Sc., Ph.D.	1964-75
1965-1985		
Charnetski, W. A.	B.Sc., M.Sc., Ph.D.	1965-
Larson, D. J.	B.Sc., M.Sc.	1967-69
Struble, D. L.	B.A., M.A., Ph.D.	1968-
Richards, K. W.	B.Sc., M.Sc., Ph.D.	1976-
Hardman, J. M.	B.Sc., M.Sc., DIC, Ph.D.	1977-82
Hill, B. D.	B.Sc., M.Sc., Ph.D.	1978-
Schaber, B. D.	B.A., M.Sc., Ph.D.	1978-
Byers, J. R.	B.S.A., M.Sc., Ph.D.	1981-
Whitfield, G. H.	B.Sc., M.Sc., Ph.D.	1982-
Johnson, D. L.	B.Sc., M.Sc., Ph.D.	1983-

Animal Parasitology Section - Lethbridge Research Station

The Animal Parasitology Section was first established at Lethbridge in 1947 as the Livestock Insect Laboratory with R. H. Painter in charge and W. W. A. Stewart as a scientist. Both were transferred from the Dominion Entomological Laboratory at Lethbridge. There have been changes in the name of the group. In 1954, it became the Veterinary-Medical Insect Section of the Science Service Laboratory, and in 1959, it became part of the Lethbridge Research Station. In 1977, it became the Animal Parasitology Section of the Research Station.

In 1948, two scientists joined the staff. W. A. Nelson left the Crop Insect Laboratory to work on sheep keds and horse bots, and J. J. R. McLintock left the Manitoba Department of Health to work on mosquitoes and biting flies. In

1950, Stewart transferred to the Saskatoon Laboratory, and K. R. Depner was hired to work on horn flies, warbles, and lice. In 1951, C. O. Thompson joined the staff to work on chemical control of livestock insects. W. O. Haufe was transferred from Ottawa in 1953 to work on mosquitoes and microclimatology. In the same year, J. Weintraub and R. H. Robertson were transferred from the Kamloops Laboratory to work on warble flies, and McLintock was transferred to Ottawa. While at Lethbridge, McLintock set high standards of human reproduction for Canadian entomologists when he became the father of triplets. In 1955, J. A. Shemanchuk was transferred from the Saskatoon Laboratory to Lethbridge to work on mosquitoes in irrigated areas.

In 1954, Painter was appointed Liaison Officer (Livestock Insects) for the four western provinces and Haufe became the Section Head. In 1957, M. A. Khan, a veterinarian, transferred from the Nematology Section in Ottawa to work on chemical control of warbles. Painter retired in 1964. He had been in great demand over the years as a speaker on agriculture subjects, especially entomology, in the whole of Western Canada, and had become famous as an extension officer. He used his pleasant personality, his rapport with producers, his ability as a story teller, and his imaginative use of extension material to promote proper and effective control of insects with chemicals. In 1964, when the Veterinary Medical Entomology Laboratory at Guelph closed, C. C. Steward was transferred to Lethbridge to work on cholinesterase inhibition in warbles and distribution of mosquitoes. Stewart died of a heart attack in 1968. P. R. Wilkinson was transferred from the Kamloops Laboratory in 1971 to work on ticks. By 1971, all animal parasitology research in Agriculture Canada was centered at Lethbridge, except for the research on blackflies by H. Fredeen in Saskatchewan.

Between 1976 and 1985, four scientists joined the staff: W. G. Taylor to do research on pesticides and repellants, R. W. Baron to do research on immunology, J. L. Shipp to study blackflies, and J. M. Yeung to study pesticide residues. During the same period Depner, Nelson, Khan, and Wilkinson retired. In 1955, the scientific staff numbered eight and 30 years later the staff has increased by one.

Special attention has been given in the Animal Parasitology Section to the study of cattle warbles, lice, sheep keds, horn flies, mosquitoes, black flies, and ticks.

Weintraub, Thompson, and Khan tested large numbers of chemicals and developed very satisfactory controls for cattle grubs by systemic insecticides. Detailed studies were conducted on the toxicology of the chemical treatments to the host and the parasite. In cooperation with J. B. Gurba of Alberta Agriculture, Khan established area control at Forestburg to exterminate warbles on a regional basis. Weintraub studied mating, reproduction, behaviour, life history, effect of sterilants, and livestock management for warble control. He and P. J. Scholl, U.S.D.A., Kerrville, Texas, initiated a 5-year international integrated pest management program for cattle warbles in southern Alberta and Northwestern Montana. The plan for control of the warbles was to reduce the population to 0.5 per animal with insecticides and then release large numbers of sterile males to achieve eradication. The project will be completed in 1986. Robertson and Baron are studying the antibody and immune reactions of cattle to warbles and sheep to keds. They are testing vaccines that stimulate several immune responses in cattle which will be exploited in

the control of warbles. They are also identifying antibodies of horn flies, ticks, and lice in an attempt to use them as a means of controlling those pests.

Shemanchuk studied the bionomics of mosquitoes, their hibernation, and the epidemiology of mosquito-transmitted western equine encephalitis, and use of fungi as biocontrol agents for moquitoes. Depner studied photoperiod effects on mosquitoes and Haufe studied quantal responses of mosquitoes to environmental stimuli. Horn flies were studied by Depner who worked on rearing, development, diapause, photoperiod effects and parasites, and by Haufe who studied control and developed mathematical models for this insect, and determined the economic impact of the insect on the cattle industry.

Nelson studied ecology, cycling patterns, and the effect of hormones and nutrition on resistance of the host to sheep keds and cattle lice.

Depner studied the ecology, taxonomy, life history, and chemical control of blackflies in Alberta. These studies led to the developmenmt of a large-scale study of blackflies on the Athabasca River in northern Alberta in the mid-seventies by the Research Station, Alberta Agriculture, Alberta Environment, and Environment Canada. Depner, Shemanchuk, Khan, Haufe, and Charnetski (Crops Insect Section) represented the Research Station. Studies were done on methods of application of insecticides, the effect of the insecticide on blackfly larvae, nontarget arthropods, and other animals, and on insecticide residues in the water. There were also studies on repellants sprayed on the cattle, and on chemical control of the blackflies on the cattle. This work led to a satisfactory control of blackfly larvae in the Athabasca River by insecticides applied to the river.

Tick biology, ecology, and control have been studied by Wilkinson in southern Alberta and central British Columbia. He developed techniques for protection of cattle from tick paralysis and the effect of killing shrubs with herbicide on tick populations.

Detailed studies are being conducted by Taylor on chemical structure and synthesis of pesticides and repellants and their use on warm-blooded animals. Pesticide residues and the metabolism of pesticides in animals are also being studied.

The Section has had a major impact on scientific development in livestock insect investigations and has effectively serviced the agriculture industry. Through its leadership major cooperative research has been undertaken with: USDA, INRA (France), and the Central Veterinary Laboratory (U.K.) in insect pest management and host parasite relationships of warble grubs, and in studies of insect repellants against biting flies; the USPHS in investigating acquired resistance of hosts to ectoparasites; the University of Washington in developing biological control of mosquitoes by fungal parasites; Alberta Agriculture in establishing province-wide organized control of warbles; Alberta Enviroment on effective blackfly control by river treatment of larvae; Alberta Public Health in surveys and studies of Western Equine Encephalitis by antibody measurements. The Section was instrumental in establishing the Western Committee on Livestock Pests to provide effective technology transfer to provincial and federal officials on control recommendations and scientific advances on livestock pests.

Scientists in the Animal Parasitology Section - Lethbridge Research Station

	Degrees	Years
Painter, R. H.	B.Sc., M.Sc.	1947-64
Stewart, W. W. A	B.Sc.	1947-50
Nelson, W. A.	B.Sc., M.Sc., Ph.D.	1948-82
McLintock. J. J. R.	B.Sc., M.Sc., Ph.D.	1948-54
Depner, K. R.	B.Sc., M.Sc., Ph.D.	1950-79
Thompson, C. O.	B.Sc.	1952-58
Haufe, W. O.	B.A., M.Sc., D.I.C, Ph.D.	1953-
Weintraub, J.	B.A., M.Sc.	1953-
Robertson, R. H.	B.A., M.Sc.	1953-
Shemanchuk, J. A.	B.Sc., M.Sc.	1955-
Khan, M. A.	G.V.Sc., M.S., Ph.D.	1957-84
Steward, C. C.	B.A., M.A., Ph.D.	1964-68
Wilkinson, P. A.	B.A., M.A., Ph.D.	1971-84
Taylor, W. G.	B.S.P., Ph.D.	1976-
Baron, R. W,	B.Sc., Ph.D.	1978-
Shipp, J. L.	B.Sc., M.Sc., Ph.D.	1980-
Colwell, D. D.	B.Sc., M.Sc.	1982-
Yeung, J. M. B.	B.Sc., Ph.D.	1985-

Forage Crops Section (Apiculture) - Beaverlodge Research Station

The first entomological work at the Beaverlodge Experimental Farm was done by W. D. Albright, the first superintendent. In July 1922, he obtained a beehive from the Lacombe Experimental Farm for study and demonstration purposes. Albright taught farmers in the area about beekeeping and honey production, and in 1925 and 1927, wrote articles on beekeeping in the Peace River area of Alberta. Bee colonies were kept at the Experimental Farm from 1922 until 1939.

A full-scale research program on apiculture was started in 1953 by P. Pankiw who was transferred to Beaverlodge from Ottawa. He studied European foul brood disease of bees, pollination of alsike and red clover, management of packaged bee colonies, evaluation of various bee strains for honey production under Canadian conditions, wintering bees in Canada and management of leafcutter bees for alfalfa seed production in northern Alberta.

In 1971, D. L. Nelson became Apiculturist at Beaverlodge and has done research on packaged bee production in British Columbia, bee management and honey production, chalk brood, honeybee nutrition, queen rearing, honeybee behaviour, and canola pollination.

T. Szabo joined the staff at Beaverlodge in 1974 and has done research on wintering honeybee queens, honeybee behaviour, comb building, and breeding better strains of honeybees for Alberta.

In 1978, H. Lerer started work at Beaverlodge as the apiculture pathologist but transferred to Ottawa in 1980. He was replaced in 1981 by T. P. Liu, who transferred from the Harrow Research Station where he had been a bacteriologist. Liu is studying nosema and other protozoan diseases, morphology of Asian mites, and is developing early detection methods for bee diseases.

In 1981, D. T. Fairey was hired and is studying forage seed production, quality of leafcutter bee cells, pollination of forage legumes, and biology of leafcutter bees under northern management systems.

The Beaverlodge Research Station has become a leading centre for apiculture research.

Apiculturists - Beaverlodge Research Station

	Degrees	Years
Albright, W. O.		1919-45
Pankiw, P.	B.S.A., M.Sc., Ph.D.	1953-79
Nelson, D. L.	B.S.A., M.Sc., Ph.D.	1971-
Szabo, T. I.	B.A.E., M.Sc., Ph.D.	1974-
Lerer, H.	B.Sc., M.Sc., Ph.D.	1978-80
Liu, T. P.	B.Sc., M.Sc., Ph.D.	1981-
Fairey, D. T.	B.Sc., M.Sc., Ph.D.	1981-

Entomology Section - Suffield Experimental Station

The Entomology Section of the Suffield Experimental Station was established in 1942 with A. W. A. Brown as the Head of the Section. Brown had been in charge of the Forest Insect Survey for Canada and was posted to Suffield when he joined the army. H. Hurtig, who was with the Entomological Laboratory at Lethbridge, joined the army in 1942 and was posted to Suffield in 1943 to work with Brown.

Brown left Suffield in 1948 to teach at the University of Western Ontario and Hurtig, who was seconded to Suffield from the Lethbridge Entomology Laboratory, became the Head of the Section after completing his Ph.D. at the University of California. J. J. Fettes, A. P. Randell, A. C. Raynar, W. W. Hopewell, from Forest Entomology Laboratories, Science Service, and S. L. W. Mann, a chemist, joined the staff of the Suffield Experimental Station in 1950. R. D. McMullen joined the staff in 1951 and I. S. Lindsay in 1952. L. E. Putman of the Field Crop Insect Section at Lethbridge worked for several winters at the Suffield Experimental Station.

The main areas of research at the Suffield Experiment Station included: applications of insecticides by smoke generators and aerosols; hopper and emission apparatus for distribution of grasshopper baits by aircraft; laboratory assessment and aerial application of insecticides; deposition of insecticides in the field and in a wind tunnel; penetration of spruce foliage by aerially applied insecticides; and development of prototype orchard sprayers with the Summerland Entomology Section. Some of the insects studied in their chemical control program for assessment of organic insecticides were: grasshoppers, houseflies, flour moths, flax bollworm, German cockroach, granary weevil, spruce budworm, and wheatstem sawfly. Research was also conducted on with ticks, mites, fleas, and lice, and their role in disease transmission.

The Entomology Section was closed in 1956. However, some scientists left prior to the closing. Fettes returned to Forest Entomology in 1953, as did Randell

and Raynar in 1954. At the time that the Entomology Section was closed down, Mann joined the Defence Research Board, Special Weapons Section, Ottawa; Hurtig became Head of Toxicology for Science Service, Ottawa; Lindsay joined the Defence Research Board, Environmental Protection Section, Ottawa; McMullen joined the Fruit Entomology Section at the Research Station, Harrow; and Hopewell returned to Forest Entomology, Ottawa.

Entomology Section - Northern Forestry Centre

The Entomology Section of the Northern Forestry Centre had its origin in Calgary as the Forest Insect Laboratory, Entomology Division, Science Service, Canada Department of Agriculture. The administrative headquarters of the Laboratory were in the Dominion Public Building and a permanent field laboratory was established at the Dominion Forestry Station at Seebe. The laboratory was a remodelled H building that had been used by the army as part of a prisoner-of-war camp during World War II. The building contained the laboratory and living quarters for three married couples and three rooms for single staff.

G. R. Hopping, formerly Officer-in-Charge of the Forest Insect Laboratory at Vernon, B.C., was transferred to Calgary on May 6, 1948, to take charge of the Laboratory. R. W. Stark, a new Forestry graduate from the Univerity of Toronto, started work in May as a technical officer. C. G. McGuffin was transferred from the Winnipeg Laboratory in June to take charge of the Forest Insect Survey and act as a nucleus for the forest insect ranger service. Four rangers, two summer students, R. W. Reid and J. A. Cook, and a stenographer were added to the staff during the year.

The territory covered by the staff included all the National Parks from the Rocky Mountains westward including Banff, Jasper, Kootenay, Yoho, Waterton Lakes, Glacier, and Revelstoke, as well as all the Alberta Provincial Forest areas, and the Northwest Territories. The Forest Insect and Disease Survey on this area was begun, and research was started on the lodgepole pine needle miner, which was in outbreak phase over 1000 square kilometers in Banff, Kootenay, and Yoho parks, and a small area of Jasper Park. Since 1948 many scientists, rangers, and technicians have worked on the Forest Insect and Disease Survey which now covers all of Alberta, Saskatchewan, Manitoba, and the Northwest Territories, and the National parks of Banff, Jasper, Kootenay, Yoho, and Waterton Lakes.

The scientific staff increased between 1951 and 1960 with the addition of R. W. Reid, R. F. Shepherd, W. H. Henson, J. A. Cook, M. E. P. Cumming, C. E. Brown, and J. M. Powell. Henson, Stark, and Cook left between 1955 and 1957. New scientists hired in the sixties were R. E. Stevenson, H. F. Cerezke, L. Safranyik, H. A. Tripp, J. H. McGhehey, G. N. Lanier, and A. G. Raske. During this period McGuffin and Brown were transferred to Ottawa, Hopping retired, and Cumming moved to Victoria.

Between 1970 and 1972, Lanier and McGhehey left, Raske was transferred to the Newfoundland Laboratory, and Shepherd, Safranyik, and Tripp were transferred to the Victoria Laboratory. In 1980, Stevenson left to take a position with Alberta Fish and Wildlife.

In 1971, a new Forestry Laboratory was built in Edmonton south of the University of Alberta. The staff in this Laboratory included specialists in entomology, pathology, soils, land classification, silviculture, environmental pollution, forest genetics, and plant physiology. The Calgary and Winnipeg Laboratories were closed and H. R. Wong, W. G. H. Ives, and J. A. Muldrew were transferred to Edmonton from Winnipeg. In 1972, G. T. Silver, an entomologist, joined the Northern Forestry Centre as its Director where he remained until he retired in 1980. Since then, P. A. Amirault and B. H. Moody have joined the staff and Reid has retired.

The Laboratory has had several name changes and has been placed in several different Departments in the Government. In 1952 it became the Forest Biology Laboratory, Division of Forest Biology, Science Service, Canada Department of Agriculture; in 1961 it became the Forest Entomology and Pathology Laboratory, Forest Entomology and Pathology Branch, Canada Department of Forestry; in 1967 it became the Forest Research Laboratory, Forestry Branch, Canada Department of Forestry and Rural Development; in 1967-68 it became the Forest Research Laboratory, Forestry Branch, Canada Department of Fisheries and Forestry; in 1971, it became the Northern Forest Research Centre, Canadian Forestry Service, Environment Canada; in 1984 it made the full circle as it moved out of Environment Canada into Agriculture Canada where it started in 1948; in 1985 the Laboratory became the Northern Forestry Centre, Canadian Forestry Service, Agriculture Canada.

Some of the areas of work of the Laboratory have been distribution, dispersal, life history, biology, ecology, morphology, taxonomy, and control of forest insects. The survey of forest insects and diseases has been carried on since the Laboratory started and has been supervised successively by McGuffin, Reid, Brown, Tripp, Ives, Hiratsuka, Moody, and Cerezke.

The staff has included 23 scientists and many technicians and rangers. Both the scientists and the support staff have jointly and individually authored many research and extension papers. A bibliography of the entomology papers by the Canadian Forestry Service for the Prairies Region of Canada from 1927-77 was published by Smith (1978).

The main insects that the scientists have worked on are: bark beetles (especially Ips and Dendroctonus), lodgepole pine needle miner, spruce gall aphid, mountain pine beetle, forest tent caterpillar, root collar weevil, white spotted sawyer beetle, Engelmann spruce weevil, bruce span worm, spruce budworm, larch sawfly, birch leaf miner, gall insects, geometrids, and sawflies.

Reports, leaflets or papers have also been written about: pine needle scale, box twig borer, pine needle tier, seed and cone insects, terminal weevils, pear slug, poplar gall mite, scale insects, aphids, green ash bug, spruce needle miner, pitch nodule maker, shoot-boring sawfly, poplar borers, and the lilac leaf miner.

Scientists in the Entomology Section - Northern Forestry Centre Edmonton, Alberta

	Degrees	Years
Hopping, G. R.	M.S.	1948-1963
McGuffin, C. G.	Ph.D.	1948-1962
Stark, R. W.	Ph.D.	1948-1956
Reid, R. W.	Ph.D.	1951-1982
Shepherd, R. F.	Ph.D.	1953-1970
Hensen, W. R.	Ph.D.	1953-1955
Cook, J. A.	M.S.F.	1953-1957
Cummings, M. E. P.	M.S.	1954-1966
Brown, C. E.	M.S.	1955-1966
Powell, J. M.	Ph.D.	1959-
Stevenson, R. E.	M.S.F.	1960-1980
Cerezke, H. F.	Ph.D.	1960-
Safranyik, L.	Ph.D.	1964-1972
Tripp, H. A.	M.S.	1965-1970
McGhehey, J. H.	M.S.	1967-1970
Lanier, G. N.	Ph.D.	1967-1970
Raske, G. N.	Ph.D.	1968-1974
Muldrew, J. A.	M.S.	1971-1984
Wong, H. R.	Ph.D.	1971-
Ives, W. G. H.	M.S.	1971-
Silver, G. T.	Ph.D.	1972-1980
Moody, B. H.	Ph.D.	1982-
Amirault, P. A.	M.S.	1985-

Past and Future

In the very near future, the influence of the first professional entomologist in Alberta, E. H. Strickland, will end as the last of his students finish their careers in entomology. Strickland and 22 of his students have worked at the Lethbridge Research Station and have played an important role in entomological research in Alberta during the last 73 years.

Strickland always practiced and taught that to solve insect problems the entomologist had to observe the insects where they were causing their damage and try to modify their environment to reduce their damage below economic levels, and do this without causing other ecological problems. What he taught and what has been practiced by many federal governement entomologists in Alberta since the twenties is now known as 'integrated control' or 'insect pest management'.

Over the years many entomologists have retired or left Research Institutions without publishing all their data. Thus, the information has not become available to other scientists. One reason for this is that some scientists have tried to solve the whole problem of their research before they publish and then have found that the large amount of data that they have accumulated is difficult to organize, digest and publish. But, when publication is 'encouraged', scientists tend to think 'publication' and chop their work into pieces that can be readily published. The publications, however, should be

interrelated parts of the solution to the whole problem so a comprehensive major paper can be published when the problem is solved. Another advantage of emphasizing publication is that scientists, when writing a paper, tend to fill in the gaps, rethink their work, and review the literature again with the new information they have obtained from their research.

Federal entomologists in Alberta have received support for both applied and basic research over the years and have shown that the two types of research blend into one another. The scientists have successfully controlled most of the insect pests and have provided considerable fundamental information for entomologists and other professionals. Many scientists have not only published scientific papers but have also published extension papers that have had an immediate impact on the extension workers and the farmers. Although most papers published by federal institutions tend to give the credit to scientists, the support staff such as technicians, summmer students, editors, reviewers, and stenographers usually have made significant contributions to the publication also.

In the future some well known insects will again create spectacular outbreaks and new pests will arrive in the province. Many of the insect outbreaks will be due to weather conditions that favor insect survival and reproduction. Weather will also be extremely important in terminating the outbreaks. Attempts will be made to make insect outbreaks more predictable and, with the tools we now have available, we may succeed.

To control insects in the future new insect-resistant varieties of crops will be developed, genes will be manipulated, antigens will be tested, new insecticides will be developed, eradication will be considered, and sterile-male techniques, monitoring, and crop management will be improved.

Insects and man are both quite adaptable and will continue to compete for food and space. In this competition there will always be scientists who find insects fascinating and will get great pleasure from studying those that are pests, those that are beneficial, and those that are just beautiful. The young entomologists who are just starting their careers will continue to manage insects for the benefit of man and will probably do so with techniques that are only now being developed.

Acknowledgments

I greatly appreciate the work of those who have published papers on entomology in Alberta in the past and those who have put unpublished material into archives at various locations. I have received information and help from many entomologists and would like to especially thank L. A. Jacobson, W. A. Charnetski, J. Weintraub, K. R. Depner, H. Cerezke, and D. L. Nelson.

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HISTORY OF ENTOMOLOGY 1905-1985

Alberta Government Departments

J. B. Gurba*

Introduction

The Alberta Government has been involved in entomology since the province was formed in 1905. In the early years, there was less distinction between federal and provincial agencies. All staff were mainly involved in coping with insect pest breakouts. Over the last 80 years, the general policy has been that the Canada Department of Agriculture (CDA) is responsible for research and the Alberta Department of Agriculture (ADA) is responsible for extension and program development. However, there has been considerable overlap of activities with a general collaborative team approach to problem solving.

Provincially, ADA has been the main department involved in providing a service for the protection of crops and livestock from insect, animal, and disease pests; the promotion of apiculture and protection of other beneficial insects; and the promotion of safe, effective use of pesticides. In 1971, Alberta Environment became the main department responsible for training and regulation of pesticide use, and the control of mosquitoes and other biting flies. Alberta Health was involved in insect vectors of human diseases under entomologist, J. H. Brown.

Due to limitations of time and space, this paper will attempt to cover only a few highlights of the evolution of entomology at the provincial government level over the last 80 years. A list of provincial entomologists is appended for further reference.

Background

Early settlers soon discovered that native insects threatened crops, livestock, and the health and welfare of man. Grasshoppers, wireworms, cutworms, wheat stem sawfly, lice, ticks, mosquitoes, and other biting flies took their toll. Introduced species such as the warble fly, European corn borer, Colorado potato beetle, and the alfalfa weevil added to the problem.

There were many pioneers in public service who assisted with the insect pest problem. E. H. Strickland was the first federal entomologist at the Lethbridge Experimental Farm, founded in 1906. His work on grasshoppers, wireworms, cutworms, and other crop insect pests still stand as models today. Control recommendations were developed with farmers by provincial agricultural staff. The district agriculturist (DA) service, started in 1920, became the main extension agency.

In 1922, Professor Strickland founded the Department of Entomology at the University of Alberta and until his retirement, 32 years later, he continued active work in research, teaching, and extension. At the Lethbridge Research

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Station, the Entomology Section continued under the capable leadership of H. L. Seamans, C. W. Farstad, N. D. Holmes, S. McDonald, and D. L. Struble. Federal and university entomologists provided the research information which was applied by provincial extension workers to farms and homes across Alberta.

Provincial Organization and Operation

In Alberta, ADA has taken an integrated approach in handling crop pests such as insects, plant diseases, vertebrate pests and weeds (1983) under a crop protection service. This has provided a team approach to the farmer's crop and livestock pest problems. The first crop protection specialist in ADA was A. M. Wilson, a plant pathologist - 1936, followed by J. L. Eaglesham - 1942, W. Lobay - 1947, J. B. Gurba - 1957, and M. K. Price - 1983. Specialists were added as department staff and budgets increased to cope with newer, more complex problems.

Entomology specialists in the Crop Protection Branch began with J. P. Proctor - 1961, L. K. Peterson - 1965, and M. G. Dolinski - 1972. The Crop Clinic commenced under D. Stelfox in 1961 to provide a pest diagnostic and applied research service. It developed into the Plant Industry Laboratory under R. D. Dixon in 1971 and B. Bolwyn in 1975 and was transferred to the Alberta Environmental Centre, Alberta Environment, Vegreville, in 1979. H. G. Philip, M. Y. Steiner, and other entomologists at the Alberta Environmental Centre have continued to provide diagnostic, monitoring, and special investigative services to agriculture, environment, and other agencies.

During this period, decentralization was strongly promoted by the Alberta Government and Regional Crop Laboratories were established at Brooks, Olds, and Fairview to provide regional diagnostic and applied research-extension services. The first regional entomologists were U. Soehngen, Brooks - 1979, R. Butts, Fairview - 1981, and E. Mengersen, Olds - 1980. The control of livestock insects was gradually transferred to the Animal Industry Division under B. A. Khan in 1980.

The Apiculture Branch operated in various parts of ADA under S. O. Hillerud - 1929-38, W. G. le Maitre - 1939-56, J.W. Edmunds - 1956-70, W. G. Awram - 1971-74, and U. Soehngen - 1974-79. Apiculture was transferred to the Crop Protection Branch in 1979 with the headquarter office decentralized to Falher under D. MacDonald, Supervisor of Apiculture, and D. Colter, Chief Apiculture Inspector.

The Agricultural Chemicals Act and regulations effected in 1970 under ADA were transferred in 1971 to Alberta Environment. L. K. Peterson transferred with the program to head the Pesticide Chemicals Branch until retirement in 1985 when B. W. Taylor replaced him.

Besides staff and facilities, solving insect pest problems requires the same basic combination of factors as with most problems. Three major factors are often illustrated by the 3E concept of Engineering - Education - Enforcement.

The Engineering in insect pest management has been provided by researchers at public institutions and in industry in the form of husbandry techniques, resistant varieties, insecticides and application equipment, integrated pest management, etc.

The Education has been provided mainly by a variety of provincial agencies and methods ranging from public schools to colleges, universities, DA's, Agricultural Fieldmen, publications, radio, and television. Courses ranged from general pest control to special training courses for pesticide inspectors and dealers. Publications range from grasshopper control to complete manuals for crops such as forage, barley, and canola.

The Enforcement has been provided by several acts which set the rules and regulations for pest control. There are many acts, but I will deal briefly with the main three:-

1. Pest Control Products Act (Canada).--This federal act regulates the registration and sale of all pesticides used in Canada, including insecticides.

2. Agricultural Pests Act.--Enacted in Alberta in the early 1920's to provide for the control of pests. About 1930, it was amended so that the control of any "declared pest" became the responsibility of every citizen and every municipal government. Control could be enforced by the issuing of a written notice. The act and regulations were updated and revised in 1960 and 1974.

   The following insect pests have been declared: grasshopper (1931), warble fly (1943), Dutch elm disease, and its two bark beetle vectors (1978).

3. Agricultural Chemicals Act.--Enacted in Alberta in 1970 to govern the use and application of fertilizers and pesticides. It deals with Alberta conditions and provides specific regulations beyond the federal PCP Act such as the training and licensing of commercial applicators, testing and use permits, restricted pesticides, etc.

The combination of engineering, education, and enforcement has been used to establish a variety of insect pest management recommendations and programs from the early 1900's to the present.

A further requirement for successful programs and best use of public funds is the coordination of effort of all government agencies. In Alberta, this has been accomplished to a large degree by a number of officially appointed interagency committees.

The first of these was the Pest Control Advisory Committee (PCAC) established in 1957 to review research and advise ADA on control programs, including effective and safe use of pesticides. PCAC members included federal, provincial, university, and industry representatives from agriculture, health, fish and wildlife, forestry, and other disciplines. PCAC and similar committees reported to the Crop Production Board which in 1965 became the ADA Coordinating Committee, chaired by the Deputy Minister and reporting to the Minister of Agriculture.

Credit for developing PCAC goes to two far-sighted pioneers, A. M. Wilson, Field Crops Commissioner, ADA, and C. W. Farstad, Head, Entomology Section, CDA Research Station, Lethbridge. Their spirit of team approach and cooperative action to resolve problems set the pace for those who followed over the next 30 years.

Many other coordinating committees were later established to deal with new situations. Two of these were the Alberta Interdepartmental Committee on Pesticides (AICP 1965) and the Agricultural Chemical Advisory Committee (ACAC 1971). Brief details on these and other committees are provided later in this report. Such committees interrelated with regional and national committees and provided a mechanism to deal logically and effectively with new insect outbreaks, pesticide residues, environmental and health concerns, and other complex problems that developed over the years.

Successful programs also depend on an effective delivery system to farms and homes. Alberta is fortunate to have Agricultural Service Boards (ASB), which started in 1945 and became established in most (66) counties and rural municipalities. The DA is a member of the ASB and works closely with the municipal Agricultural Fieldman to implement programs approved by the ASB and the municipal council. Program costs are shared, usually on a 60-40 provincial-municipal basis. The Agricultural Fieldman is trained and appointed as a weed inspector, pest control officer, and agricultural chemicals inspector so that advice and assistance can be followed up with enforcement if necessary.

Municipal ASB's have helped to carry out successful programs such as grasshopper and warble fly control. Agricultural Fieldmen have provided updated control recommendations, handled approved insecticides, and monitored their safe, effective use. For outbreak pests such as grasshoppers and Bertha armyworm, ADA has stocked and supplied approved insecticides to farmers through ASB.

The value of having a trained and experienced corp of federal, provincial, industry, and municipal staff was well-demonstrated during the August 1971 unexpected outbreak of Bertha armyworm. Lannate (methomyl) insecticide got temporary registration within 48 hours. Chemical stocks, spray planes, and mixing crews were lined up within a few days in affected municipalities. Within two weeks, 250,000 acres of rape were sprayed and saved from serious damage, a scant week or so before harvest. Many other programs have been operated as effectively, economically, and safely, but not quite as dramatically.

The above description of provincial organization and operation is a brief outline of major factors involved. There are many other organizations and "unsung heroes" involved in insect pest management including thousands of knowledgeable, efficient Alberta farmers and ranchers.

To illustrate the evolution of insect pest management recommendations and programs over the last 80 years, a few brief highlights are listed in the following five time frames:

A. Period 1905-45

During the period 1906-22, E. H. Strickland and other federal entomologists at Lethbridge, Saskatoon, and Winnipeg worked out basic cultural and chemical control measures for serious crop pests such as grasshoppers, cutworms, and wireworms by crop rotation, resistant or less susceptible crops, cultivation practices, early or delayed seeding, and the use of poison baits containing arsenic or Paris Green.

During 1922-45, research and development continued on the control of major crop and livestock pests: grasshoppers, various cutworms, wireworms, root maggots, hessian fly, wheat stem sawfly, warble fly, livestock and human lice, and mosquitoes. Provincial extension agents recommended good husbandry or balanced farming; today the concept is known as Integrated Pest Management (IPM) to include all available control methods.

The 10-year grasshopper outbreak of 1931-40 was the most destructive and costly in the history of Alberta. Sodium fluosilicate replaced arsenic as a safer poison and the carrier for the bait changed from sawdust-bran to sawdust-feed flour. Over the 10 years, ADA cost was $750,000; an estimated 9 million acres of crop were saved at an approximate cost of 8.4¢ cents per acre.

Tractors and mechanized equipment replaced horses and manual labor especially during World War II, allowing faster and timely cultivation to control weed, disease, and insect pests. Mechanical bait spreaders provided more effective control of grasshoppers and cutworms. During 1936-45, wheat stem sawfly caused up to 70% damage in some southern Alberta wheat fields. Resistant crops, fall cultivation, trap strips, and early harvest provided partial control. The first sawfly-resistant wheat, Rescue, was developed and made available to farmers in 1946.

B. Period 1946-55

Following World War II, the first synthetic pesticides were developed -- 2,4-D herbicide and DDT insecticide. Despite environmental problems discovered some 20 years later, the advent of the DDT group of insecticides was a definite breakthrough in insect pest control. Along with new boom-type field sprayers and high pressure sprayers for livestock, farmers and ranchers developed the mechanisms for large scale, effective and economic insect pest control.

In 1948, ADA field-tested and first used chlordane insecticide as a safer, more effective replacement for arsenic and sodium fluosilicate used in grasshopper baits. In 1949, CDA and ADA cooperated in a project to field-test aircraft application of chlordane for large area control of grasshoppers in the Bow Island area. Since chlordane was not registered or available in Canada, ADA imported and formulated 90,000 lb technical chlordane for use as a first field spray to replace grasshopper bait.

Aldrin had been field tested and in 1950, it was supplied to replace chlordane as a grasshopper spray. The application rate was reduced from 12 to 2 ounces actual per acre and the cost from 56¢ to 35¢.

In 1951, dieldrin was field-tested and provided effective control at 1 ounce actual costing 15¢ per acre. Aldrin stocks were gradually used up and fully replaced by dieldrin in 1958. In retrospect, dieldrin has proven to be the most effective and economic grasshopper insecticide to date. At the low rate of application by knowledgeable farmers, it probably was the safest for use on cereal crops and wasteland.

In 1955, ADA supplied approved cannisters and gas masks to DA's, ASB fieldmen, and grain companies to provide for safer fumigation of insect-infested grain.

C. Period 1956-65

In 1956, infestations of European corn borer were exterminated at Medicine Hat and Brooks by destruction of all corn crop residues. Alberta remained free of this pest for some 25 years.

In 1957, the Crop Production Board was established with subcommittees in soils, fertilizers, weed control, and pest control to review research and advise ADA on programs and effective, safe use of agricultural chemicals. The Board became the Alberta Agricultural Coordinating Committee in 1965 to coordinate all activities of ADA with the advice of research agencies.

In 1959, Publication 139, "Chemical Control of Insect Pests", was first issued recommending effective but safe insecticides, emphasizing dangers of improper use, residue problems, wait periods to harvest or slaughter, hazards to humans, livestock, fish and wildlife. It has been updated and revised annually since as "Control of Field Crop Insects", "Control of Livestock Insects", "Control of Garden Pests", etc. Recommendations are based on the guides developed for Western Canada by the Western Committee on Livestock Pests (1959) and the Western Committee on Crop Pests (1962).

In 1959, the Forestburg Warble Test Project was established in cooperation with the Lethbridge Research Station and local agencies. Over a 3-year period, about 20,000 total cattle were sprayed each fall on over 200 farms with recent systemic insecticides to test extermination of the warble fly on a large area basis and safety to humans, cattle, and other life. Results showed that the warble fly could be exterminated in typical cattle country if most cattle were treated for several years.

In 1960, a special publication "Grasshopper Control on Forage and Pasture" was issued to deal with insecticide residues in milk and meat products. Aldrin and dieldrin were not used on feed crops but recommendations were made for the use of toxaphene, malathion, and Sevin.

Action was initiated to survey for pesticide residues in food, hold agricultural chemical schools, and to investigate the licensing of commercial pesticide applicators.

In 1961, monitoring for pesticide residues in milk and dairy products was commenced by the Food Laboratory with field investigations coordinated by Plant Industry Division staff to determine and eliminate problems. When the Silent Spring publication appeared in 1961, Alberta had a coordinated action program well underway.

In 1962, the first agricultural chemical dealer's school was held. These were expanded to cover all districts over the next five years with about 90 one-day training schools held for DA's, Agricultural Fieldmen, dealers, and farmers.

In 1963, the Food Residues Committee was formed within ADA to direct investigations, analysis, and liaison with other agencies. The Food Laboratory handled pesticide problems for all departments, analyzing between 1500 and 2000 samples annually for many years.

Dimethoate proved effective in field tests and was supplied by ADA to replace malathion and dieldrin as an effective, less persistent insecticide for grasshopper control. Declaration forms had to be signed by farmers purchasing grasshopper insecticides. ASB fieldmen handled the insecticide, provided instructions, and supervised proper use.

In 1964, ADA cooperated with the Department of Health in a 4-day Pesticide Training School for provincial and municipal staff. Concern was expressed to urban and rural municipalities regarding pesticide spray programs with encouragement to use training courses and specialist's advice.

In 1965, ADA cooperated with the Department of Health in establishing a correspondence course on pesticide application at the University of Alberta.

The Alberta Interdepartmental Committee on Pesticides (AICP) was established as an advisory, operational, and liaison interagency group, with representatives from provincial and federal health, fish and wildlife, and agriculture, to review all pesticide problems, and report to the Minister of Agriculture, and through his office to the Ministers of Health and Lands and Forests. All positive cases of pesticide residue over tolerance were investigated to determine and eliminate the source of contamination.

D. Period 1966-75

In 1966, the wireworm seed treatment project on storage and germination was completed with the Saskatoon Research Station. Results showed that treated seed could be used the following year rather than dumped, which provided a hazard to domestic and wildlife.

Several larvicides were field-tested to replace DDT in control of blackfly larvae in streams of northern Alberta, in cooperation with Alberta Fish and Wildlife and the University of Alberta. This was a continuation of the investigation of the blackfly problem on cattle in the Athabasca area, which commenced in 1963.

In 1967, several less persistent alternates for aldrin were field-tested in cooperation with the Lethbridge Research Station for control of root maggots in turnips, cabbage, radish, and onions. A working committee under AICP developed the first mosquito control bulletin for Alberta, Publication 673-2, "A Guide for the Control of Mosquitoes in Alberta Municipalities, Parks, Camps, and Resorts", based on DDT and malathion. Deodorized malathion was developed and recommended as a replacement for toxic fumigants in controlling grain-infesting insects and mites.

In 1968, a 5-day Pesticide Training Course commenced at Olds College as an annual updating for pesticide applicators, government inspectors, and others concerned with pesticide use and safety. The course was supported and operated by the various agencies of AICP and has served thousands of participants to date.

In 1969, the mosquito control bulletin was revised to remove DDT from recommended use and to include malathion, abate, and baytex, proven successful in field tests. Dursban was field-tested in the City of Edmonton control program.

In February 1970, the Alberta Government issued a Summary Statement on Pesticides and Mercury in Alberta following an extensive interagency investigation of mercury in game birds in 1969-70 under AICP. The government stated that it intended to continue testing and recommending the use of safer, less persistent pesticides. In the years that followed, pesticides such as mercury, DDT, and dieldrin were replaced but not banned as occurred in other provinces. Banning was considered a dramatic and expedient political solution but created a new problem of left-over, unwanted chemicals.

In 1970, the Agricultural Chemicals Act was enacted following two years of work by an interdepartmental committee from Agriculture, Health, and Lands and Forests. Regulations were drafted to establish programs of training and licensing of pesticide applicators, control of pesticide storage, transport, handling, disposal, etc. The program was transferred to the new Pesticide Chemicals Branch, Alberta Environment, in the fall of 1971. An interagency Agricultural Chemical Advisory Committee was continued to review the program and advise the Minister.

In August 1971, the Bertha armyworm outbreak on rape surprised everyone. A new insecticide, Lannate, was applied by 48 Canadian and U.S. aircraft within a 2-week period on 250,000 acres of rape. Most of the rape crop was saved with only slight damage. The infestation continued during 1972-74. Blacklight traps were established at 17 locations across the province to provide an early warning system.

In 1972, warble control increased through a cooperative program with all ASB's funded 50% by ADA. Over the next five years, the average grub infestation was reduced from about 40% to 5%. The development of pour-on and spot-on treatments made warble control easier than with spraying. However, some cattle owners still declined to treat.

In 1973, a multi-discipline team of federal, provincial, and university scientists began a 4-year study of the blackfly problem and its control on the Athabasca River under the Alberta Blackfly Coordinating Committee. A final report outlined the parameters of river treatment and future operations.

In 1974 and for the next few years, the grasshopper outbreak forecast did not develop to forecasted economic levels due to a series of cool, wet springs.

The public hearings on pesticides conducted by the Environment Conservation Authority kept many biologists occupied for the next few years but provided a useful review and recommendations for proper use of pesticides in the future in a report issued in 1976.

E. Period 1976-85

In 1976, 93% of cattle were in warble control areas. Surveys of sales outlets indicated 95% of cattle were grub-free. Three municipalities opted out of the compulsory control program but were included when the whole province was made a warble control area in March 1978.

Following several years of field research in the County of Newell, an alfalfa seed field monitoring program commenced in 1978, funded and supported by federal, provincial, and ASB agencies. General pesticide use decreased, leafcutter and honey bee kills decreased, and alfalfa seed yields increased. About 50 alfalfa seed growers participated with over 4000 acres of alfalfa in 100 fields. Since 1981, the growers have paid for the full cost of the Integrated Pest Management program -- the first grower-financed IPM program in Alberta, and possibly in Canada, developed by joint government initiative.

During this period, several important publications were funded by ADA: "Insect Pests of Alberta" by H. G. Philip, 1977 and "A Bibliography of Alberta Entomology 1883-1977" by A. M. Harper.

In 1978, Dutch elm disease (DED) and its two beetle vectors were declared pests under the Agricultural Pests Act. A coordinated committee of federal, provincial, and municipal entomologists, pathologists, foresters, and parks people has met annually to coordinate operations to keep Alberta DED free. A bark beetle monitoring program in southern Alberta did not trap any beetles. No DED has shown up in the large plantings of elms in cities and farm shelterbelts to date, a truly amazing success story of preventive joint action.

In 1979, the government decentralization program was applied to several important services. The Plant Industry Laboratory was transferred to the Alberta Environmental Centre, Vegreville, in April 1979. Regional Crop Laboratories at Brooks, Olds, and Fairview were staffed with entomologists and plant pathologists to investigate regional problems and to provide diagnostic/extension services. Apiculture services were decentralized with the HQ office at Falher and regional offices at Brooks and Edmonton.

The Farming for the Future program commenced in 1979, and has provided funding to federal, university, and private research organizations during the last seven years when research money has been scarce. Entomology/apiculture research has ranged from development of a northern-hardy Alberta honey bee to protection of livestock from biting flies, and monitoring of insect outbreaks with pheromone traps.

In 1981, the European corn borer was found in 21 corn fields in the Medicine Hat area, ending some 25 years of freedom from this pest. Eradication measures reduced the outbreak but the corn borer has gradually spread westward across southern Alberta.

In 1982, M. A. Hussain was appointed the first Pesticide Issues Coordinator to review problems and to ensure the health and safety of farmers and the public. Over the next few years, Pesticide and Safety Courses were developed for use by DA's at farm meetings and a Guide to Crop Protection manual was developed/updated for the control of insects, diseases, and weeds.

Livestock insect work was transferred to the Animal Industry Division under the direction of B. A. Khan in 1980. For the new few years, emphasis was placed on the warble control program. ADA provided support to the joint CDA-USDA research program aimed at warble fly extermination by large area control using insecticides and the sterile male technique (1982-85).

In 1984, drought and its associated crop pests returned to southern Alberta. About 300,000 hectares were treated for grasshoppers and 70,000 hectares for pale western cutworms. The drought and pests continued in 1985. Grasshopper treatment exceeded 600,000 hectares in one of the worst outbreaks in history. Insecticide supplies ran short and ADA airfreighted supplies from the United States. A rebate of 50% of insecticide costs was provided to drought-stricken, cash-short farmers.

In a sense, the wheel has come full circle. Historically, ADA supplied free grasshopper baits to farmers until 1949. From then until the late 1970's, ADA purchased, stockpiled, and supplied approved spray insecticides to farmers through local ASB's. Through mass purchase, costs were kept down to less than half of the market price. In the early 1980's, ADA phased out as a main supplier as the chemical trade agreed to provide a reliable supply at competitive prices.

The grasshopper problem in 1985 confirmed that entomology in Alberta still has many challenges. Forecasting needs improvement, modern sprays are short-lasting and expensive, and the joint effort of all government agencies continues to be needed by farmers in technical and financial support.

Alberta entomologists and allied workers can take pride in the progress made in apiculture and Insect Pest Management over the last 80 years. However, many challenges remain to be met today and in the future.

References

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Plant Industry Division Annual Reports, 1974-75.

Entomologists - Alberta Agriculture

Apiculture

S. O. Hillerud	Provincial Apiarist	1929-38
W. G. le Maistre	Provincial Apiarist	1939-56
J. W. Edmunds	Supervisor of Apiculture	1956-70
W. J. Awram	Supervisor of Apiculture	1971-74
U. Soehngen	Supervisor of Apiculture Regional Entomologist, Brooks	1974-79 1979-
D. N. MacDonald	Supervisor of Apiculture	1979-
D. A. Colter	Chief Apiculture Inspector	1979-

Crop Protection Branch

J. B. Gurba	Assistant Supervisor Branch Head	1953-56 1957-83
J. P. Proctor	Assistant Supervisor	1961-64
L. K. Peterson	Assistant Supervisor Supervisor, Entomology & Pesticides	1965-70 1970-71
M. G. Dolinski	Supervisor of Entomology Section Head Entomology/Pathology/Apiculture	1972-85 1985-

Plant Industry Laboratory (PIL)/Alberta Environmental Centre (AEC)

R. D. Dixon	Entomologist, PIL Head, PIL	1968-71 1971-74
H. G. Philip	Head, Entomology Section, PIL Head, Crop Protection Group, AEC	1972-79 1979-
M. Y. Steiner	Entomologist, PIL Special Crops Entomologist, AEC	1973-79 1979-
H. J. Liu	Entomology Section, AEC	1980-85
R. A. Butts	Regional Entomologist, Fairview Head, Entomology Section, AEC	1981-85 1985-
E. A. Mengersen	Regional Entomologist (Olds College)	1980-
B. A. Khan	Pest Control Specialist Animal Industry Division	1980-

Entomologists - Alberta Agriculture

Pesticide Chemicals Branch

D. Pledger	Section Head	1973-
D. B. Stewart	Section Head	1974-
J. Harlos	Biologist	1980-
P. Scholefield	Biologist	1981-
B. Taylor	Biologist and Section Head Branch Head	1974-85 1985-
L. K. Peterson	Branch Head	1970-85
G. Byrtus	Biologist	1978-
A. J. McIntosh	Biologist	1976-
W. Inkpen	Biologist	1974-

Research Management Division

M. J. Gurba	Contracts Administrator	1979-
R. Leech	Research Manager	1974-78
R. R. Wallace	AOSERP, Chairman Aquatic Fauna Committee	1974-77
B. A. Khan	AOSERP, Research Manager Lands Systems	1977-80

BIONOMICS OF BLACK FLY SPECIES FOUND IN THE MAJOR WATERWAYS OF SOUTHERN ALBERTA

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Twenty-one species of black flies (8 Prosimilium, 1 Twinnia, and 12 Simulium) were collected from 22 rivers and creeks in southern Alberta from 1981 to 1983. Seasonal population dynamics of Simulium arcticum Malloch (IIL-3), S. defoliarti Stone and Peterson (IISS-14.15), and S. tuberosum Lundstrom (FG) were determined for 4 rivers in southern Alberta from 1982 to 1984. Simulium arcticum and S. tuberosum were multivoltine with 2 or 3 generations per year while S. defoliarti was univoltine.

The effect of selected environmental factors on the seasonal abundance of black fly immature stages was determined for 6 black fly species (Prosimulium and Simulium spp.). Water temperature, river discharge, and turbidity were the only factors that were significantly correlated to the seasonal abundance of black fly larvae. Food quality and quantity may also have a great effect on larval growth and development of black fly species that inhabit the rivers of southern Alberta.

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SELF-TREATMENT STATIONS FOR CATTLE FOR THE CONTROL OF BLACK FLIES

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Black flies cause considerable losses in livestock production in the northern parts of Alberta. In 1972, a black fly outbreak in the Athabasca region resulted in 135 animal deaths. The annual treatment of the Athabasca River with methoxychlor to control black fly larvae provides partial suppression of the black fly activity.

Various on-farm cattle protection techniques were evaluated for the control of adult black flies. These techniques were either too expensive or labor-intensive to incorporate in the routine management of pastured cattle.

Therefore, a study to develop a simple technique for the administration of insecticide to cattle was initiated by the Beef Cattle and Sheep Branch. A forced-use self-treatment method was developed to help cattlemen to combat black fly problems at the farm level.

Two identical pastures, each equipped with its own dugout, served as treatment and control pastures. Two cow-calf groups of 250 and 200 of mixed commercial breeds served as treatment and control groups, respectively. Access to the dugout in the treatment pasture was controlled by installing fence and gates. The gates were equipped with pest-doom oilers. The cows were forced to walk under the oilers daily while obtaining drinking water. The cattle oilers were dichlorvos 0.25% insecticide oil solution sold as Ciovap commercially.

Black fly and mosquito activity was monitored using a sweep net sampling method at 2-day intervals.

This technique was highly effective in dispensing chemical onto the cows. The cost of the insecticide was $0.03 per cow per day or $1.35 per cow over the 45-day study period. The treatment reduced total black flies by 48.8% ($P < 0.01$), mosquitoes by 64.3%, and total blood-feeding flies by 49.1%. The

chemical treatment also resulted in elimination of horn flies and reduction of face flies. Neither loss of hair on the back of animal nor skin irritation has been observed in treated animals due to Ciovap treatment. Udders, eyes, and ears of treated cows were devoid of insect bites.

In conclusion, this self-treatment method of application of insecticide to cattle forced to walk under the black rubber oiler is an effective and easy method of reducing blood-feeding fly activity. Conventional high pressure body spraying requires more labor for the round-up of cattle and results in physical stress and interrupted grazing. This was avoided by the continuous self-treatment method.

Further, this treatment method is 50% cheaper than impregnated ear tag application and would appear to have a superior level of mosquito and black fly control.

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AREA-WIDE SYSTEMATIC INSECTICIDE TREATMENT FOR CONTROL OF CATTLE GRUBS: TWO APPROACHES (PART I)

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AREA-WIDE SYSTEMATIC INSECTICIDE TREATMENT FOR CONTROL OF CATTLE GRUBS: TWO APPROACHES (PART II)

P. J. Scholl
USDA-ARS, Kerrville, TX

As part of the Joint USA-Canada Cattle Grub Project, an evaluation was made of the progress of two different governmental approaches toward eradication of cattle grubs, Hypoderma spp. In the United States, governmental assistance to purchase insecticide and provide labor to apply the chemical was used as an inducement to achieve 100% cooperation. In Canada, legislation requires treatment of all cattle with costs for treatment borne by the individual stockowner. Compliance is monitored by Canadian government inspectors in the spring, in auction markets and at slaughter facilities, and during followup visits to farms with infested cattle.

Evaluation of the two approaches was accomplished by extensive on-ranch examination of cattle in the spring following each fall's treatment and by weekly examination of segregated, untreated, monitor cattle on both sides of the border.

Although both approaches substantially reduced populations of grubs by more than 90%, neither achieved the long-range goal of eradication. Samples of untreated cattle indicated reinfestation rates as high as 84% and resulted in recommendations for utilization of integrated management techniques to complement the progress achieved with chemical control strategies.

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THE INVERTEBRATE ZOOLOGY PROGRAM AT THE PROVINCIAL MUSEUM OF ALBERTA

A. T. Finnamore
Provincial Museum of Alberta, Edmonton, AB

The Invertebrate Zoology Program was established in August, 1983. This presentation will illustrate the development of this new program in the areas of collections, public displays, and research.

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THUNDERFLY THRIPS: LIMOTHRIPS CEREALIUM (HALIDAY) (THYSANOPTERA: THRIPIDAE) - A FILM

I. F. Chisholm and T. Lewis
Rothamsted Experimental Station, Harpenden, Herts. AL5 ZJQ, U.K.

(Presented by B. S. Heming, Department of Entomology, University of Alberta, Edmonton, AB)

Feeding in adults of the grain thrips, Limothrips cerealium, was examined by cinematography as they fed through a transparent membrane on a liquid containing small, polystyrene latex particles that made its flow visible. The "labral pad" of the mouthcone makes close contact with the substrate and the single left mandible is used to pierce the membrane. It is then withdrawn rapidly and replaced by the maxillary stylets. These form a tube with a terminal or subterminal opening into which is drawn the fluid by cibarial pumping at 2-6 pulses/sec. (Oscillations in the surrounding fluid resulting from such pumping were detectable up to 58 um from the stylet opening.)

Feeding persists from a few seconds to 0.5 h at which time the stylets are withdrawn either rapidly and together or gradually by sliding one against the other.

Thrips consumed the contents of ruptured plant cells at 8.5×10^{-5} ul/min - a rate equivalent to about 12.5% of their body weight per hour. Whole chloroplasts up to 6 um diameter can be ingested even though the diameter of the maxillary canal is only 1 um.

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SEX PHEROMONE AND MONITORING OF THE EUROPEAN CORN BORER, OSTRINIA NUBILALIS, IN ALBERTA

D. L. Struble and J. R. Byers
Agriculture Canada Research Station, Lethbridge, AB

The sex pheromone of the European corn borer population established near Medicine Hat resembles that of the Iowa strain. A potent attractant inhibitor was discovered. Monitoring the population density and range expansion of this species with pheromone-baited traps will be discussed.

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MONITORING ABUNDANCES OF CUTWORM MOTHS IN SOUTHERN ALBERTA WITH SEX PHEROMONE TRAPS, 1978-85

J. R. Byers and D. L. Struble
Agriculture Canada Research Station, Lethbridge, AB

Monitoring of the temporal and spatial abundance patterns of eight species of cutworm moths at 81 locations with a 13,000 km^2 (5,000 mi^2) area of southern Alberta was begun in 1978. The results show that reliable estimates of relative population levels are obtained and that the potential for subsequent larval infestations can be predicted. Outbreaks of Bertha armyworm and pale western cutworm that occurred during the course of the study were successfully forecast.

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ALTERNATIVE METHODS OF GRASSHOPPER CONTROL

D. L. Johnson
Agriculture Canada Research Station, Lethbridge, AB

In 1985, over 700,000 ha in Alberta were sprayed with chemical insecticides to control grasshoppers. Two alternative methods of control, based on microbes and insecticides on bait, have potential to ensure that insecticides are used efficiently, to reduce damage by grasshoppers in cases in which chemicals cannot be used, and to decrease risk to the environment and the user. Recent experiments have shown that 1) grasshoppers infected with microsporidian Nosema locustae at sub-lethal levels feed significantly less than healthy individuals; 2) low rates of application of spores induce epizootics of the same magnitude as high rates; and 3) carbaryl on wheat bran provides adequate roadside grasshopper control (75% kill) at one-fifth the price of spraying.

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ON THE ADAPTIVE SIGNIFICANCE OF BUMBLE BEE COLOR POLYMORPHISMS

R. E. Owen
Department of Biology, University of Calgary, Calgary, AB

Bumble bees (Hymenoptera: Apidae: Bombus) are brightly colored insects with distinctive color patterns, which probably serve an aposematic (warning) function. There are numerous examples of Batesian mimics of bumble bees found in the Diptera (mainly Syrphidae and Asilidae). There is considerable convergence of color pattern between different bumble bee species. This can be ascribed in part to common ancestry and in part to Müllerian mimicry. However, some Bombus species are polymorphic for color pattern. B. melanoplus has a color dimorphism controlled by a single gene locus with the allele for red pile dominant to that for black. The gene frequencies form a cline along the west coast of North America, and analysis indicates that a minimum selection intensity of approximately 1% acting on the queens is sufficient to maintain the cline. Selection for Müllerian mimicry may favor the red morph in the north and the black morph in the south, thus generating the cline.

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SPATIAL AND TEMPORAL VARIATION IN EGG PARASITISM OF LIMNOPORUS DISSORTIS (GERRIDAE) BY A SCELIONID WASP

J. R. Spence
Department of Entomology, University of Alberta, Edmonton, AB

The local and regional population dynamics of the waterstrider, L. dissortis, are profoundly influenced by interactions with a scelionid egg parasitoid, Tiphodytes gerriphagus. The parasitoid causes 80-95% mortality of gerrid eggs by early July throughout the prairie provinces and apparently restricts L. dissortis to temporary habitats where wasp populations periodically become extinct. Eggs of L. dissortis are susceptible to parasitism through the first 80% of embryonic development. However, in the field, there is no significant increase in parasitism observed with increasing host age, suggesting that wasps locate eggs rapidly after oviposition.

Overall rates of parasitism were weakly correlated with local egg density but the general pattern of the correlation shifted from inverse density dependence to positive density dependence over the season. This trend was stronger when only rates of parasitism for discovered egg batches were considered in the analysis. Throughout the season, rates of discovery by wasps were inversely related to number of gerrid eggs at a site. Areas of different host density within a single pond showed different rates of parasitism. This observation results from lower probability of discovery in areas of lower host density; the conditional probability of parasitism given discovery did not vary between areas.

Experimental data showed that wasps are attracted to oviposition sites, mainly as a result of gerrid activity. Presence of territorial gerrid males actually increased rates of egg parasitism. Thus, the inverse density dependence observed for parasitism at discovered sites must be exclusively a function of low wasp density early in the season.

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SENSORY RECEPTORS ON LEGS OF GERRIS REMIGIS (HETEROPTERA: GERRIDAE) WITH SPECIAL REFERENCE TO PUTATIVE CHEMORECEPTORS

K. P. Fennie
Department of Entomology, University of Alberta, Edmonton, AB

Males and females of Gerris remigis detect surface waves produced by prey, and use this ability (in part) to capture prey. G. remigis males can signal and perceive signals on the water surface. Location and structure of mechanoreceptors involved in perceiving surface signals are not known. It is here suggested that the mechanoreceptors involved in perceiving surface waves are located on the three leg-pairs and could possible involve trichobothria, three types of campaniform sensilla, and two types of hair plates. Putative chemoreceptors found on male mesothoracic and metathoracic femora and trochanters possible function in detection of a contact pheromone emitted by the females. These putative chemoreceptors were present on four of twelve species surveyed.

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TWO SPECIES OF PROCLADIUS (DIPTERA: CHIRONOMIDAE) FROM A NORTHERN PRAIRIE MARSH: DESCRIPTIONS, PHEONOLOGIES, AND MATING BEHAVIOR

D. A. Wrubleski
Department of Entomology, University of Alberta, Edmonton, AB

and

S. S. Roback
Academy of Natural Sciences of Philadelphia, Philadelphia, PA

Two species of Procladius (Diptera: Chironomidae) with similar life histories were found to differ in morphology and mating behavior. P. nietus Roback and P. deltaensis n. sp. are described with observations on their abundances, habitat preferences, phenologies, and mating behavior in the Delta Marsh, Manitoba, Canada. Both species are univoltine with concurrent, synchronous spring emergence. Differences in morphology, post emergence movements and behavior prevent mating between these similar species. P. deltaensis is a substrate swarmer, whereas P. nietus is a typical aerial swarming species.

DISTRIBUTION AND LIFE HISTORY OF THE MOUNTAIN MIDGES (DIPTERA: DEUTEROPHLEBIIDAE) OF WESTERN NORTH AMERICA

G. W. Courtney
Department of Entomology, University of Alberta, Edmonton, AB

Mountain midges (Diptera: Deuterophlebiidae) are a presumedly rare aquatic insect from western North America and eastern Asia. They are considered strict stenobionts, requiring cold, high-gradient mountain streams. During this research, deuterophlebiids were collected at approximately 400 locations in western North America, from latitudes of 35°N (California, New Mexico) to 65°N (Yukon Territory). These records provide considerable geographic range extension and demonstrate that mountain midges are more widespread along altitudinal gradients than previously suspected. Quantitative samples indicate that deuterophlebiid abundances can approach 2000 individuals/m^2 (rock surface area) in many streams. Mountain midge life histories are largely unknown. This paper presents an overview of deuterophlebiid life history, and detailed comments on oviposition and overwintering stage hypotheses.

VOLATILE ALGAL LIPIDS: HABITAT MARKERS FOR SHORE INSECTS

W. G. Evans
Department of Entomology, University of Alberta, Edmonton, AB

Habitats of shore insects, such as carabid beetles and saldid bugs, invariably support diverse assemblages of algae that produce a variety of volatile lipids with distinctive odors. These lipids, consisting mostly of hydrocarbons, fatty acids, and fatty acid methyl esters, accumulate in the soil and in dead algal mats. All carabids and saldids tested so far (approximately 25 species) showed positive olfactory responses to extracts of their habitat soil or algal mats or to the soil and algae directly. Preliminary findings suggest that shore insects recognize their habitats by detecting the volatile lipids and that habitat specificity is the result of specific bouquets of these compounds.

SURVIVAL OF CEUTORHYNCHUS LITURA, AN INTRODUCED WEEVIL FEEDING ON CANADA THISTLE AT BUSBY, ALBERTA

A. S. McClay
Alberta Environmental Centre, Vegreville, AB

Ceutorhynchus litura (F.) (Coleoptera: Curculionidae) is a European weevil which feeds specifically on Canada thistle, Cirsium arvense (L.) Scop. It has been introduced into five Canadian provinces as a possible biological control agent for this weed. It was released at Busby, Alberta, in 1978, on land adjoining the University of Alberta Department of Entomology Field Station. Signs of its survival were detected in 1979 and 1980, but the site was then not monitored until late 1985. In August 1985, the site was revisited and adult C. litura were found to be still present. The insect has spread up to about 70 m from the point of release. In one patch, 45% of the thistle stems were mined by the larvae. In 13% of the attacked stems, the main shoot had been killed, but this was compensated by growth of an axillary shoot. Around the point of release, the thistles have declined from a dense infestation to scattered small plants. However, this decline is not necessarily the result of the weevil attack. The slow rate of increase and dispersal of C. litura appears to be one factor which limits its usefulness as a biological control agent for Canada thistle.

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COLONIZATION OF LODGEPOLE PINE STUMPS BY ANTS (HYMENOPTERA: FORMICIDAE) IN HINTON, ALBERTA

J. Wu and H. R. Wong
NoFRC-CFS, Edmonton, AB

Stumps of lodgepole pine, Pinus contorta Dougl., were colonized by 6 common species of ants four years after being cut. The most prevalent species were Myrmica incompleta Provancher on wet sites, and Formica neorufibarbis Emery on dry sites. The two species showed no preference for size of the stumps colonized. The other four common species of ants showed a distinct preference for large stumps of lodgepole pine. Two or three of the common species were observed inhabiting the same large stump in a few cases. The majority of the stumps contained only a single species. Decomposition of the stumps by ants and other organisms generally took 16 to 29 years depending on site conditions.

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THE LODGEPOLE PINE TERMINAL WEEVIL, PISSODES TERMINALIS HOPKINS, (COLEOPTERA: CURCULIONIDAE) IN ALBERTA

J. A. Drouin
NoFRC-CFS, Edmonton, AB

The lodgepole pine terminal weevil, Pissodes terminalis Hopkins, attacks the terminal shoot of lodgepole pine and jackpine in Alberta. The life history of P. terminalis differs in jack pine and lodgepole pine. Attacks on lodgepole occur in mid to late summer, while those in jack pine in late spring. Infested leaders of jack pine have a mean diameter of 5.6 mm with generally one larva per shoot, while those of lodgepole pine have a mean diameter of 12.0 mm with frequently more than one larva per terminal. Larvae overwinter in the shoots of lodgepole pine but not in jack pine.

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STRUCTURE, FUNCTION, AND EVOLUTION OF GROUND BEETLE MANDIBLES (COLEOPTERA: CARABIDAE)

J. H. Acorn
University of Alberta, Edmonton, AB

Carabid mandibles are complex structures, which occlude in a precise fashion. Mandible structure is correlated with the type of food eaten. I have constructed a transition series between various mandible types, which may give insights into the evolution of mandible structure in this group.

ATTACK PATTERN AND BROOD PRODUCTIVITY OF MOUNTAIN PINE BEETLE ON THREE PINE HOSTS

H. F. Cerezke
NoFRC-CFS, Edmonton, AB

Green-cut log bolts of three native Alberta pine hosts, lodgepole, limber, and jack pines, were placed in infestation areas of the mountain pine beetle (Dendroctonus ponderosae Hopk.) in southwestern Alberta during July and August, 1984. The bolts were allowed to become infested during adult beetle flight, then brought to the laboratory where they were placed in rearing cages to collect all emergent mountain pine beetles. The bolts were then debarked, adult galleries counted and measured, and beetle progeny were sexed and measured to compare data from each pine host.

There was little evidence in support of preferential pine host selectivity at each site. However, major differences between the three pine hosts were obtained in total numbers of galleries excavated, gallery density, and average gallery length. Major differences were also apparent in brood productivity from each pine host and in average beetle size. These differences are presumed to be attributed largely to differences in host tree characteristics and may have important implications in the population dynamics of the beetle.

WHY ARE THERE SO MANY SPECIES OF WEEVILS?

R. S. Anderson
Department of Entomology, University of Alberta, Edmonton, AB

The tremendous species diversity of weevils (over 60,000 described species) may be due to the tendency for adult weevils to have initially used the snout for adult feeding followed by a shift to use by females primarily, if not exclusively, for excavation of an oviposition site. This shift is inferred to have led to increased protection for the immature stages and to have allowed for the development of specialized feeding habits. It is further proposed that this shift in use of the snout occurred prior to the origin of angiosperms, and that weevils were already highly diversified both structurally and in terms of their feeding habits at that time. Subsequent coevolution with angiosperms further enhanced species diversity.

Measurements of the length of the membranous telescoping ovipositor and of the snout in females of the genus Curculio are highly positively correlated supporting the contention of the functional relationship between the two structures. Examination of the fossil record and of the host plant associations of primitive weevils shows association of primitive weevils primarily with primitive plants and suggests, as hypothesized, an initial radiation prior to the origin of angiosperms.

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A SMALL SETOSE SELENOPHORINE, AND A SLOG IN THE BOG OF TAXONOMIC UNCERTAINTY (COLEOPTERA: CARABIDAE: HARPALINI)

G. E. Ball
Department of Entomology, University of Alberta, AB

Most species of Carabidae are rather readily assigned to genera by means of character-state combinations that offer convincing evidence of relationship. For one group of tropical harpalines, the Selenophori, generic limits are not sharp, and so some species are not easily assigned to genera. One such taxon, here designated "X." overali, new species, is known only from eastern Brazil. Character-states of this species are such that it may be a member of the otherwise southeast Asia Dioryche MacLeay, or of either of the South American genera Amblygnathus Dejean or Selenophorus Dejean, or it may represent a new genus. A decision based on present knowledge will be arbitrary, and the resulting generic assignment seems unlikely to indicate the relationships of this remarkable species.

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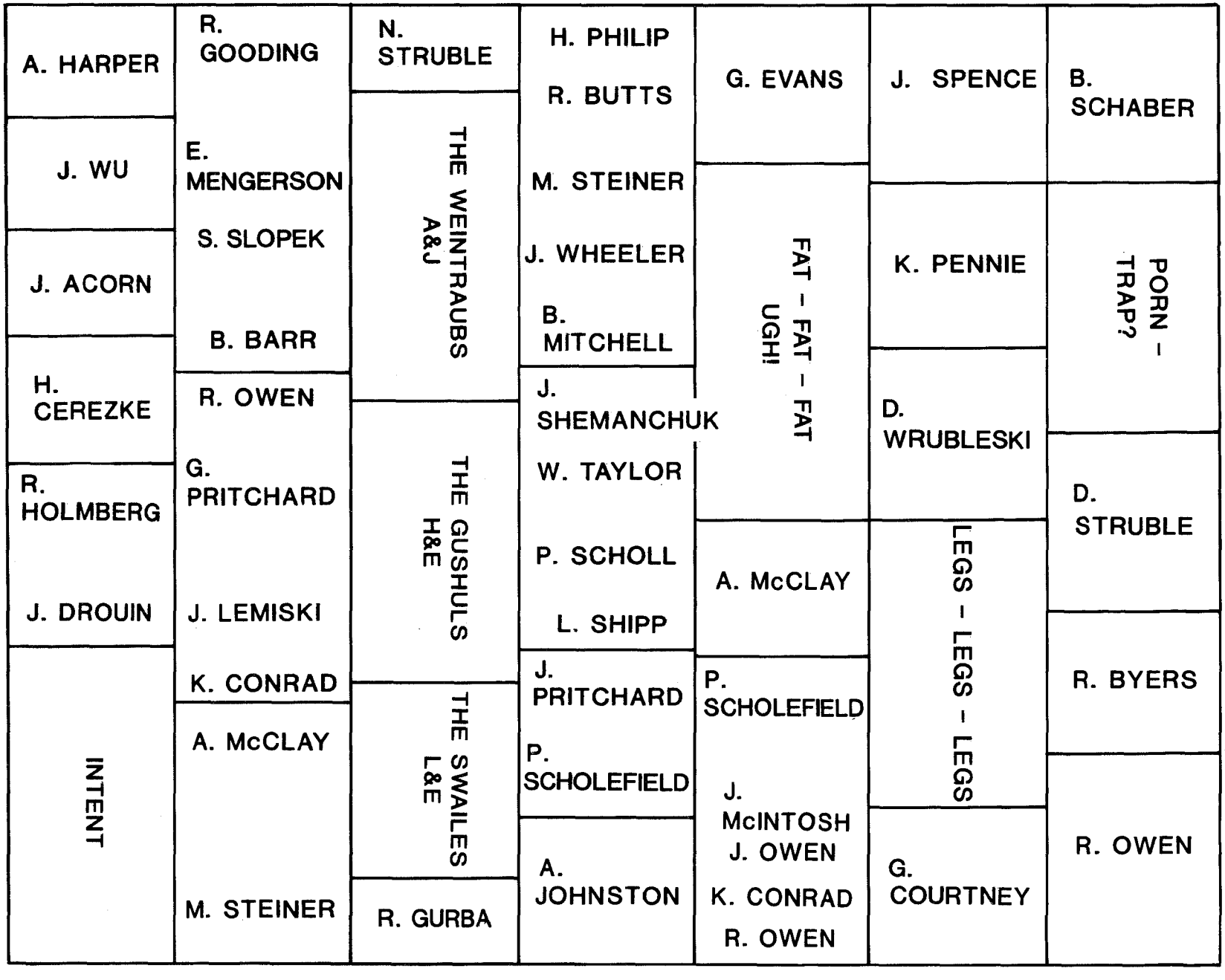
Photographic Highlights


A. HARPER
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S. SLOPEK
B. BARR
R. OWEN
G. PRITCHARD
J. LEMISKI
K. CONRAD
A. McCLAY
M. STEINER
N. STRUBLE
THE WEINTRAUBS A&J
THE GUSHULS H&E
THE SWAILES L&E
R. GURBA
H. PHILIP
R. BUTTS
M. STEINER
J. WHEELER
B. MITCHELL
J. SHEMANCHUK
W. TAYLOR
P. SCHOLL
L. SHIPP
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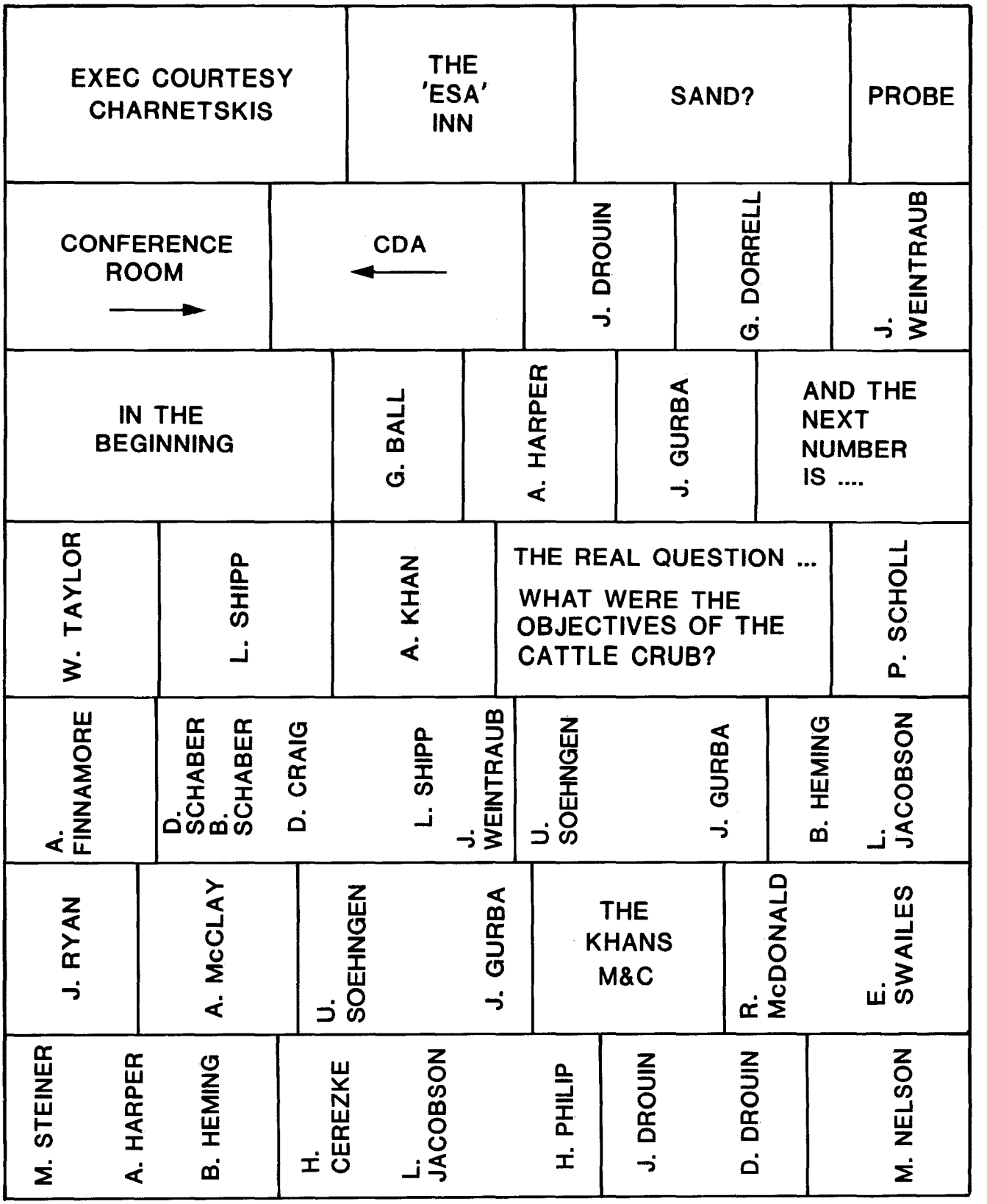
ENTOMOLOGICAL SOCIETY OF ALBERTA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AND THE NEXT NUMBER IS ....
W. TAYLOR
L. SHIPP
A. KHAN
THE REAL QUESTION ...
WHAT WERE THE OBJECTIVES OF THE CATTLE CRUB?
P. SCHOLL
A. FINNAMORE
D. SCHABER
B. SCHABER
D. CRAIG
L. SHIPP
J. WEINTRAUB
U. SOEHNGEN
J. GURBA
B. HEMING
L. JACOBSON
J. RYAN
A. McCLAY
U. SOEHNGEN
J. GURBA
THE KHANS M&C
R. McDONALD
E. SWAILES
M. STEINER
A. HARPER
B. HEMING
H. CEREZKE
L. JACOBSON
H. PHILIP
J. DROUIN
D. DROUIN
M. NELSON

CONFERENCE ROOM

Objectives of the Joint Cattle Grub Project

- Eradication by IPM
- Efficacy against both species
- Economic evaluation
- Supplemental studies

33rd ANNUAL MEETING - LETHBRIDGE - 1985

ENTOMOLOGICAL SOCIETY OF ALBERTA

Executive Meeting

Alberta Agriculture
Provincial Building, Olds, Alberta

April 13, 1985

Present: Bill Charnetski, Doug Craig, Jim Drouin (Chairman), Ron Gooding, Robert Holmberg, Bill Nelson, Marilyn Steiner

Absent: Colin Hergert, Bruce Taylor

1.0 Call to Order

The meeting was called to order at 10:45 a.m.

2.0 Adoption of Minutes

MOTION: That the minutes of the executive meeting of November 1, 1984, be adopted.

Holmberg - Charnetski. CARRIED.

3.0 Business Arising from Minutes

3.1 Informing Teachers about Entomology

A summary of the results as well as copies of the actual questionnaires were sent to the President of the Science Council of the Alberta Teachers' Association.

Copies of the summary will also be distributed to the membership at the Annual Meeting.

3.2 Photographs for the Proceedings

To clarify honorarium payments, the following motions were made:

MOTION: That the usual honorarium payment be made to the appointed photographer, Bill Nelson, for taking photographs of the 1984 Annual Meeting and preparing them for publication in the Proceedings.

Craig - Charnetski. CARRIED.

MOTION: That Bill Nelson be re-appointed as the Society's photographer for 1985.

Holmberg - Craig. CARRIED.

4.0 Treasurer's Report

MOTION: That the auditors' report on the 1984 Financial Statement be accepted.

Charnetski - Craig. CARRIED.

A financial report on the Society's finances up to the end of March showed that the Society had about $9,000 in assets.

The treasurer was asked to request the $200 grant available to regional societies from the Entomological Society of Canada.

5.0 Editor's Report

Present plans are for the Proceedings to be published by Athabasca University for about $500. The print run will be 160.

An attempt will be made to pass the information electronically from Agriculture Canada's computer in Lethbridge to Athabasca University's computer.

A list of the 1985 committees and their membership will be published in the Proceedings.

Whether or not a 10+ year cumulative index will be produced will depend on someone volunteering to prepare it.

Distribution of the Proceedings will be done by courier and other services so that distribution costs to the Society will be eliminated. Distribution should occur by mid-May.

6.0 Report of the Meeting Committee

The following tentative decisions have been made:

1) The wine and cheese reception and the paper presentations will be held at the Agriculture Canada Research Station in Lethbridge.

2) The dates will be October 17-19 (alternatively October 10-12).

3) A session on the "History of Entomology in Alberta" may include talks concentrating on the federal government, provincial government and educational institutions.

4) The organizers will recruit volunteers to process the registrations.

7.0 Secretary's Report

A few routine items of correspondence were reported.

The membership report showed that about 18 new members were recruited, mostly from the Universities of Alberta and Calgary; only about 20% of the membership is in arrears.

It was decided to postpone consideration of another honorary member until the stability of the increased membership is known.

8.0 Other Business

8.1 New Executive Positions

To re-distribute the workload of the Secretary-Treasurer position, the following proposal was made:

MOTION: That the Secretary-Treasurer position be split into two, namely, a Secretary and a Treasurer; the Treasurer to retain the responsibility for memberships.

Holmberg - Gooding. CARRIED.

R. Holmberg to prepare a notice of motion about the above to be distributed with the Proceedings.

8.2 Aims of the Society

R. Holmberg to prepare a proposal for discussion at the Annual Meeting about the Society making a contribution to the CanaColl Foundation (formed "To promote taxonomic research on the Canadian National Collection of insects and related arthropods").

8.3 Long Term Planning

MOTION: That the Regional Director to the Entomological Society of Canada invite the national Society to hold the 1990 meeting in Alberta.

Gooding - Charnetski. CARRIED.

8.4 Next Meeting

Next meeting will likely be Saturday, August 17. R. Holmberg and J. Drouin to determine the feasibility of holding the meeting by tele-conferencing.

9.0 Adjournment

The meeting adjourned at 1:15 p.m.

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Executive Meeting

Teleconference Connections Between
Athabasca, Calgary, Edmonton, and Lethbridge

August 15, 1985

Present: Bill Charnetski, Doug Craig, Jim Drouin (Chairman), Ron Gooding, Colin Hergert, Robert Holmberg, Bill Nelson, Jim Ryan

Absent: Marilyn Steiner

1.0 Call to Order

The meeting was called to order at 7:00 p.m.

2.0 Adoption of Minutes

MOTION: That the minutes of the executive meeting of April 13, 1985, be adopted.

Gooding - Craig. CARRIED.

3.0 Business Arising from Minutes

3.1 Informing Teachers about Entomology

No word about the effectiveness of the questionnaire; Robert to ask the President of the Science Council of the Alberta Teachers' Association.

Copies of the summary to be distributed to membership at the Annual Meeting.

4.0 Treasurer's Report

A verbal summary was given; Robert to check on sale of insect boxes.

5.0 Editor's Report

Publishing of the Proceedings has been delayed, electronic exchange of material has not been possible.

Colin volunteered to work on a cumulative index for 1953-1970.

MOTION: That the cumulative index have the same format (i.e., author, subject, and keywords from title and abstract) as the first cumulative index.

Charnetski - Gooding. CARRIED.

If anyone had any objections, they were to contact Colin.

6.0 Report of the Meeting Committee

The following decisions were confirmed:

1) The dates will be October 17-19.

2) The locations will be the Sandman Inn for the reception and banquet; the Research Station for the presentations.

3) The symposium on "History of Entomology in Alberta" will go ahead as planned.

4) The guest speaker will be Alex Johnston.

5) The costs will be $10 for registration and $15 for the banquet ($10 for students who are E.S.A. members).

7.0 Committee Membership to E.S.C.

Committees as decided at general meeting.

(Secretary's note: Though the Rules and Regulations indicate that the term of office of the Regional Director to the E.S.C. is for only 2 years, this was changed in 1977 to agree with the national society's 3-year term. See minutes of General Meeting of 1984.)

Doug to check about status, if any, of Public Education Committee.

8.0 Secretary's Report

A few routine items of correspondence were reported.

9.0 Other Business

9.1 Insect Boxes

It was decided to continue the practice of the Entomology Department of the University of Alberta purchasing insect boxes for sale and charging the Society for the cost.

9.2 Joint Meeting

A letter to the E.S.C. indicating E.S.A.'s willingness to host the 1990 meeting in Alberta has been sent.

9.3 Insect Collections

Colin to send copies of information and rules about the insect collection competition to the University of Alberta.

Doug to locate and make known the names of the winners of competition held in Vegreville.

9.4 Photographs

Duplicate prints used to prepare Proceedings to be sent to University of Alberta for general distribution.

10.0 **Adjournment**

The meeting adjourned at 9:00 p.m.

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Executive Meeting

Home of Bill Charnetski, Lethbridge, Alberta

October 17, 1985

Present: Bill Charnetski, Doug Craig, Jim Drouin (Chairman), Ron Gooding, Bill Nelson, Colin Hergert, Robert Holmberg, Jim Ryan, Marilyn Steiner

1.0 Call to Order

The meeting was called to order at 5:00 p.m.

2.0 Adoption of Minutes

MOTION: That the minutes of the executive meeting of August 15, 1985, be adopted.

Holmberg - Ryan. CARRIED.

3.0 Business Arising from Minutes

3.1 Science Council of Alberta Teachers' Association

R. Holmberg contacted the President and found out that the Council appreciated our efforts to inform them about entomology; however, there is no information as to whether the questionnaire responses were used by any teachers.

3.2 Joint Meeting with E.S.C.

MOTION: That the E.S.C. be invited to meet with E.S.A. in Alberta in 1991.

Craig - Charnetski. CARRIED.

3.3 Insect Box Sales

D. Craig indicated that the Society would have to spend about $1000 to obtain another 300 insect boxes; Doug agreed to arrange the purchase and see about obtaining copies of the insect-collecting booklet for distribution with the insect boxes and by Society members.

3.4 Public Education Committee of the E.S.C.

There has been some confusion about this committee. It is now evident that the Regional Director is automatically a member.

3.5 Awards Committee

D. Craig to see that A. Liew receives a scroll as part of his award.

4.0 Treasurer's Report

MOTION: That the interim Treasurer's report be accepted.

Holmberg - Hergert. CARRIED.

This report was also to be presented at the Annual Meeting.

5.0 Editor's Report

B. Charnetski indicated that the Proceedings were to be distributed at the Annual Meeting. The cumulative index to 1982 is to include subject headings, authors, scientific names, and titles of presented papers; index to be published separately.

6.0 Report of the Meeting Committee

B. Nelson indicated that everything was in order.

7.0 Place and Time of the 1986 Annual Meeting

MOTION: That the next annual meeting be in Edmonton in 1986.

Craig - Ryan. CARRIED.

President to communicate this decision to the Plant Pathology Society of Alberta and to offer them a copy of our membership list so that they can approach our members about attending their meeting in Vegreville and joining their society.

It was further suggested that the dates be November 5-7.

8.0 Secretary's Report

See minutes of Annual Meeting for membership report.

Members generally thought that the last executive meeting that was held by teleconference went all right and that some future executive meetings could be held in the same way, as long as they did not cost the Society too much and did not do away with face-to-face meetings.

9.0 Adjournment

The meeting adjourned at 6:00 p.m.

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Annual Meeting

Lethbridge, Alberta

October 19, 1985

1.0 Call to Order

The meeting was called to order at 10:30 a.m. by J. Drouin. About 34 members were present.

2.0 Adoption of Minutes

MOTION: That the minutes of the last annual meeting be adopted.

D. Craig - H. Philip. CARRIED.

3.0 Business Arising from Minutes

3.1 Entomology and the Schools

A summary of the responses to the questionnaire about the willingness of members of E.S.A. to address teachers or their students on entomological topics was distributed at the Annual Meeting and a copy sent to the Science Council of the Alberta Teachers' Association.

4.0 Report of the Officers

4.1 Treasurer's Report

MOTION: That the Treasurer's interim report be accepted.

R. Holmberg - J. Shemanchuk. CARRIED.

4.2 Editor's Report

A verbal report was given on the production of the Proceedings, the progress of creating the 10-year index, and the list of former Society officers and banquet guest speakers.

It was noted that the invited papers are to be published in the Proceedings.

MOTION: That the Editor's report be accepted.

B. Charnetski - H. Wong. CARRIED.

4.3 Meeting Committee's Report

B. Nelson, on behalf of the committee, thanked everyone who helped and attended.

4.4 Secretary's Report

There was no noteworthy correspondence to report.

A membership report is provided at the end of the minutes. New memberships have increased substantially in the last two years. These new members have brought the total up to the point where another honorary member could be considered.

(Secretary's note: The following people were removed from the membership list in 1985 because they had not paid dues for three or more years or we have no current address:

D. Colter, D. Currie, P. Ellis, C. Ewasechko, D. Giberson, R. Lancaster, H. Liu, E. Maw, D. McCorquodale, B. Moody, R. Mutch, J. Singleton-Smith, L. Soluk, J. Sutcliffe, D. Szlabey

If anyone knows if any of the above wishes to remain a member, please notify one of the executive members.)

MOTION: That the Secretary's report be accepted.

R. Holmberg - W. G. Evans. CARRIED.

4.5 Regional Director's Report

A verbal report was given. The national meetings are scheduled as follows: 1986, October 6-8, Manitoba; 1987, July 3-9, Penticton; 1988, July 3-9, International Congress in Vancouver; 1989, not decided; 1990, Quebec City with Biological Council. A written report follows the minutes.

MOTION: That the Regional Director's report be accepted.

D. Craig - B. Charnetski. CARRIED.

5.0 Reports of Standing Committees

5.1 Awards Committee

One student prize was awarded to a University of Alberta student, Andrew Liew. The Society has sent him $100. The faculty of the Department of Entomology donated an additional $60.

5.2 Report of Representative to the Environmental Council of Alberta

A short verbal report was given. A written report follows the minutes.

MOTION: That the report of the Representative to the E.C.A. be accepted.

J. Shemanchuk - W. G. Evans. CARRIED.

5.3 Insect Collection Competition

There were 28 entries from Olds College and one junior collection submitted. The winners in the open class were: Lori Gray (first), Gary Pauly and Sue Northam (tie for second), and James Borrow (third). Honorable mention went to Ruth Mandzuk and Greg Shymanski. In the junior class, A. Douglas Macauley won a book prize. The judges were C. Hergert, Rob Hughes, and Bob Anderson.

It was suggested that the Society try to increase participation in the competition by giving out more information (including such information as date of close of competition and to whom entries should be sent) via the Proceedings and by mail to at least the Universities of Alberta, Calgary and Lethbridge, and Olds College.

MOTION: That the report of the committee be accepted.

C. Hergert - M. Steiner. CARRIED.

5.4 Nominations Committee

The following were nominated: B. Mitchell for Vice-President, A. McClay, and G. Hilchie to share the Secretary-Treasurer position (one vote for the position, with an evaluation to see if the position should be permanently split into two), E. Mengersen for Editor, B. Schaber for Director from Lethbridge, and H. Wong and H. Cerezke for auditors.

MOTION: That nominations cease.

G. Ball - D. Craig. CARRIED.

(Secretary's note: Subsequent to the meeting, K. Richards and B. Heming agreed to stand for the Science Fair Liaison and Scholarships Committees, respectively.)

5.5 Resolutions Committee

MOTION: Whereas the success of the thirty-third annual meeting of the E.S.A. can, to a large extent, be attributed to the following, be it resolved that letters of appreciation be sent to:

1) Dr. Alex Johnston for his very enlightening and interesting presentation on the early history of Lethbridge, particularly the role of the red light district in the economic and cultural development of the city;

2) Bill Nelson (Chairman), Burt Schaber, Bill Charnetski, Allan Schaaf, Les Shipp, and Joe Shemanchuk of the Lethbridge Organizing Committee for their efforts in arranging and organizing the annual meeting;

3) Dr. D. G. Dorrell, Director, Agriculture Canada Research Station for providing the meeting room and lunch facilities;

4) Bill Nelson and Ulf Soehngen for the many photographs that they took of the members and their activities for the Proceedings;

5) The management of the Sandman Inn for the facilities and banquet; and

6) George Ball, Alex Harper, and Joe Gurba for their excellent presentations on the history of entomology in Alberta.

H. Philip - B. Mitchell. CARRIED.

5.6 Science Fair Liaison

No report.

6.0 Committees to E.S.C.

No reports.

7.0 New Business

7.1 Promoting Aims of the Society

MOTION: That the E.S.A. donate $500 to the scholarship fund of the E.S.C.

R. Holmberg - G. Ball. CARRIED.

MOTION: That E.S.A. donate $200 to the CanaColl Foundation.

R. Holmberg - B. Charnetski. CARRIED.

7.2 Next General Meeting

Although the Plant Pathology Society invited E.S.A. to hold a joint meeting with them in Vegreville, there was general agreement not to accept their offer. However, the membership agreed that the Plant Pathology Society be sent a copy of our membership list.

MOTION: That the next annual meeting be held in Edmonton area with the executive to decide on the specifics.

J. Shemanchuk - R. Butts. CARRIED.

MOTION: That the E.S.C. be invited to hold a joint annual meeting in Alberta in 1991.

D. Craig - B. Charnetski. CARRIED.

8.0 Adjournment

The meeting adjourned at 12:00 noon.

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Membership Report

1. Membership 1980-86

	1980	1981	1982	1983	1984	1985	1986
Ordinary members	110	106	110	99	99	117	116
Honorary members	5	5	5	4	4	5	5
Total	115	111	115	103	103	122	121

2. Library Subscriptions 1980-86

	1980	1981	1982	1983	1984	1985	1986
Paid	3	3	3	5	5	6	6
Free	7	7	7	7	7	7	7
Total	10	10	10	12	12	13	13

3. Location of Membership (Based on Addresses Given)

a) General location (n = 121)

Location	Percentage
Alberta	92.6
Rest of Canada	3.3
Outside of Canada	4.1
Total	100.0

b) Locations within Alberta (n = 112)

Location	Percentage
Edmonton (excluding U. of A.)	24.1
U. of A.	17.9
Lethbridge	25.9
Calgary	16.1
Other	16.1
Total	100.1

4. Male/Female Ratio (n = 121)

Sex	Percentage
Male	88.4
Female	11.5
Total	99.9

5. Length of Time with Society (n = 121)

Year joined	Percentage	Subtotal percentage
1985	13.2	
1984	15.7	
1983	1.6	
1982	1.6	
1981	2.5	34.6
1980	3.3	
1979	5.0	
1978	4.2	
1977	2.5	
1976	5.9	20.9
1975	0.8	
1974	5.0	
1973	0.8	
1972	2.5	
1971	5.0	14.1
1970	2.5	
1969	1.6	
1968	2.5	
1967	4.2	
1966 + prior	20.1	30.9
Total	--	100.5

6. Membership Payments (Excluding Honorary Members, n = 116)

Year	Payment in advance/arrears	Percentage of membership	Subtotals
1987	+1	2.6	
1986	0	74.1	76.7% paid up or in advance
1985	-1	19.8	
1984	-2	3.4	23.2% in arrears
Total	-2	99.9	

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Committees 1985

Committee	Membership	Present members	End of term
A. Standing			
Council	President	J. Drouin	Dec. 1985
	Vice-President	R. Gooding	Dec. 1985
	Secretary-Treasurer	R. Holmberg	Dec. 1985
	Editor	W. Charnetski	Dec. 1985
	Past-President	M. Steiner	Dec. 1985
	Regional Director to Ent. Soc. Canada (2 year term)	D. Craig	Dec. 1985
	Ordinary Directors (3) (3 year term)	W. Nelson	Dec. 1985
		C. Hergert	Dec. 1986
		J. Ryan	Dec. 1987
Awards (to Ent. Soc. Alta. and Can.)	Past President Reg. Dir. to E.S.C. Ordinary Directors	M. Steiner D. Craig W. Nelson C. Hergert J. Ryan	Dec. 1985
Environment Council of Alberta	One elected member	J. Shemanchuk	Feb. 5, 1988
Joint meeting	Established year preceding joint meeting with Ent. Soc. Can.	None	End joint meeting
Insect Collection Competition	One elected member plus two appointed by elected member	C. Hergert	Dec. 1985
Nominations	Past-President Vice-President One member in good standing (Vice-President presents slate)	M. Steiner R. Gooding ?	End annual meeting
Resolutions	Two members appointed prior to annual meeting	? ?	End annual meeting
Science Fair Liaison	One elected, others appointed as necessary	K. Richards	Dec. 1985

Committee	Membership	Present members	End of term
A. Standing (continued)			
Auditors	Two people	H. Cerezke H. Wong	When financial statement audited
B. Entomological Society of Canada			
Common names and cultures	One elected member, 3 years	J. Spence	Dec. 1987
Membership	One elected member, 3 years	H. Wong	Dec. 1987
Public Education	One elected member ?	D. Craig	?
Scholarships	One elected member, 1 year	B. Charnetski	End annual meeting, 1985
C. Ad Hoc			
Annual meeting	Chairman Appointed by ESA Executive	B. Nelson	End annual meeting

Robert G. Holmberg
Secretary-Treasurer

ENTOMOLOGICAL SOCIETY OF ALBERTA

Financial Statement

January 1-December 31, 1985

CREDITS

Bank Balance as of December 31, 1984	$ 8,853.78
Memberships	
1987 (3 at $4.00)	12.00
1986 (80.5 at $4.00)	322.00
1985 (13 at $4.00)	52.00
1984 (3 at $4.00)	12.00
1983 (2 at $4.00)	8.00
1982 (2 at $4.00)	8.00
Exchange on memberships (3 transactions)	2.53
Library subscriptions (6 payments, includes exchange)	34.29
Subtotal for memberships	450.82
Annual Meeting 1985	
Registrations (68 at $10.00)	680.00
Banquet tickets (69 at $15.00)	1,035.00
Banquet tickets (10 at $10.00)	100.00
Subtotal for Annual Meeting	1,815.00
Miscellaneous	
Bank interest	973.74
Sale of insect boxes	329.00
Grant from Ent. Soc. Canada	200.00
Donation to scholarship fund	5.00
Subtotal for Miscellaneous	1,507.74
Total receipts	$12,627.34

EXPENDITURES

Proceedings	
Printing, 1984	$ 425.00
Photography honorarium, 1984	150.00
Photography honorarium, 1985	150.00
Binding back issues	77.00
Subtotal for Proceedings	802.00

Annual Meeting 1984	
Prize for insect collection	20.00
Annual Meeting 1985	
Dinners (78 at $11.95)	932.10
Gratuities	93.20
Reception, room and food	180.00
Advance for other expenses	200.00
Coffee supplies	42.96
Receipt books	3.60
Subtotal for Annual Meetings	1,471.86
Miscellaneous	
Donation to CanaColl Foundation	200.00
Student prize	100.00
Bank service charges	8.24
Receipt book	4.50
Subtotal for Miscellaneous	312.74
Total disbursements	$ 2,586.60

BALANCE SUMMARY

Assets	
Term deposits	$ 1,000.00
Bank balance	9,040.74
Total Assets	$10,040.74*
Disbursements	
Total Disbursements	$ 2,586.60
Grand Total	$12,627.34

*Note: As there are over $1,000 in outstanding liabilities (including $505.00 for the Entomological Society of Canada Scholarship Fund, $120.00 in prizes for the insect collection competition, $90.00 for teleconference charges, $148.26 unpaid expenses for the Annual Meeting, and costs for printing the Proceedings), the true assets of the Society are about $9,000.00.

1

RECOMMENDATIONS

As outgoing Secretary-Treasurer, I make the following recommendations (some of which have been followed as a matter of course by previous Executive members):-

1) The Society continue to build up its financial assets to about $10,000.

2) Membership revenues should approximately equal the cost of publishing the Proceedings.

3) As (2) is not true now, general membership fees should be raised from $4.00 to $6.00, the same as the library subscriptions.

4) Revenues from the Annual Meeting should be about equal to its costs.

5) Costs associated with promoting the aims of the Society should not exceed the interest revenue generated by the financial assets plus any surplus generated by other means.

If these recommendations are followed, I am sure that the Society will be able to meets its objectives without financial difficulty.

Robert G. Holmberg
Secretary-Treasurer

REPORT OF THE REGIONAL DIRECTOR

As Regional Director of the Entomological Society of Alberta, I attended the Entomological Society of Canada Governing Board Meetings, September 21, 22, and 25, 1986, at the Skyline Hotel, Ottawa.

Annual Meetings

The Annual Meeting of the Entomological Society of Canada was held jointly with the Entomological Society of Ontario. Of particular note were the three sessions of presentations by graduate students competing for prizes, one in each session. Not surprisingly, the quality of presentations was extremely high, and as a judge in one of the sessions, I found it difficult to choose a winner.

The Entomological Society of Canada was involved with the first Canadian Congress of Biology, sponsored by the Biological Council of Canada, June 23-28, 1985, University of Western Ontario, London, Ontario. Although over 800 people attended, only 20 of those attended as members of the Entomological Society of Canada. This poor attendance was probably, in part, due to the timing of the Congress.

Future Meetings

1986.- Entomological Society of Canada and the Entomology Society of Manitoba, October 6-8, Holiday Inn South, Winnipeg. Planning is well underway and notices regarding plenary sessions and symposia are already available.

1987.- Entomological Society of Canada and the Entomological Society of British Columbia, September 28-30, Delta Lakeside Motel, Penticton. The Entomological Society of Washington has also been asked to participate.

1988.- International Congress of Entomology, University of British Columbia, July 3-9. Arrangements, under the care of Dr. Scudder, are well underway. It is proposed that the normal business meeting of the Entomological Society of Canada be held then.

1989.- Venue yet to be decided.

1990.- The Entomological Society of Canada will meet jointly with the Biological Council of Canada Congress, Quebec City, Quebec.

1991.- An invitation by the Entomological Society of Alberta to meet jointly with the Entomological Society of Canada in 1990 was well received, but the date had already been preempted by the BCC Congress and the Entomological Society of Alberta was asked to consider 1991 instead.

Publications

Canadian Entomologist.--The Scientific Editor, Dr. S. Smith, Waterloo University, resigned effective July 31. I agreed to act as Chairman of a Search Committee for his replacement. Drs. Becker and McIver acted as "Editors" in the interim. Dr. A. B. Ewen, Agriculture Canada, Saskatchewan, agreed to take the position. Drs. C. H. Craig and M. K. Mukerji will be his Assistant Editors. The cost of secretarial help will be met by the Entomological Society of Canada.

Bulletin.--Dr. H. Liu resigned as Editor of the Bulletin in September. Production of the recent Bulletin was dealt with by the Assistant Editor, Dr. B. Mitchell. Dr. R. B. Aiken, Mount Allison University, New Brunswick, has agreed to become Editor, starting with the first Bulletin in 1986.

C. P. Alexander Fund.--A bequest to the Entomological Society of Canada from the Alexander Estate generates $2500 interest a year. The Publications Committee has proposed that the funds be used as page charges for one or two invited reviews in the Canadian Entomologist, or to subsidize major taxonomic papers, or those of graduate students, or as a general subsidy to reduce page charges.

Finances

As usual, the Treasurer brought in a budget with a slight deficit, but the Entomological Society of Canada is in robust financial health. Concern was expressed at the costs of providing secretarial help for the Scientific Editor. He is to report to the mid-term Executive Council Meeting after six months operation. It must be clearly understood that these are costs that the Entomological Society of Canada may have to bear fully in years to come.

The Treasurer has applied to Revenue Canada to form a charitable organization, the Entomological Society of Canada Foundation. Its purpose would be to support scholarships, seminars and symposia, entomological research in its broadest sense and, with luck, publications.

Dr. Becker, although now 2nd Vice-President, has agreed to remain as Treasurer until his replacement is found. The Entomological Society of Canada owes Becker a great deal for his long-term services as Treasurer, and this was indicated to him a number of times during the Business Meetings and elsewhere.

Awards

Scholarships:	R. De Clerck	Fellows:	H. F. Howden
	L. Provencher		J. V. Mathews
Gold Medal:	R. N. Sinha		S. C. Jay
			V. R. Vickery
Hewitt Award:	M. L. Winston		D. L. Wood

Losses Due to Destructive Insects

The study of "The Economics of Insect Control in Wheat, Canola, and Corn in Canada" is in its final draft stages by Culice and Stemeroff Company, and should be completed by mid-1986. Difficulties have been experienced in obtaining accurate information on losses due to insects. However, it has been suggested that the Entomological Society of Canada undertake a third such study on losses due to insects on livestock.

Insect Common Names

Two lists of common names are now available, the Benoit and the Watson lists. The former gives, in addition to the latin binomial, common names in French and English, the latter list gives English common names. Considerable correction is necessary on the Watson list.

Membership

It was noted that the average age of the membership was increasing and that the gradual decline in membership numbers continues. No increase in membership fees was announced, but there will be a handling charge imposed on late payments.

Officers

Past President	S. McIver
President	H. F. Madsen
1st Vice-President	G. G. E. Scudder
2nd Vice-President	E. C. Becker
Treasurer	E. C. Becker (pro tem.)
Secretary	J. A. Shemanchuk

Respectfully submitted,

Douglas A. Craig
Regional Director
Entomological Society of Alberta

REPORT OF REPRESENTATIVE OF THE ENVIRONMENT COUNCIL OF ALBERTA

As representative from the Entomological Society of Alberta on the Public Advisory Committee of the Environment Council of Alberta, I attended nine meetings of the Pollution Study Group and the 15th Annual Joint Meeting of the Public Advisory Committees and the Environment Council of Alberta. The Pollution Study Group activity studied the following issues:

1. Hazardous Waste Disposal

   In general the study group was pleased with some of the progress made in the implementation of the hazardous waste management program. Storage, transportation, and disposal of some hazardous wastes are still of concern and these are being monitored by the Pollution Study Group and other Study Groups.

2. Herbicide Use in Forest Management

   The Pollution Study group was concerned about the use of herbicides to reduce undergrowth in reforestation projects and how this practice might affect wildlife and certain flora. The acreage proposed for spraying was low at present. Future use of this practice will be monitored.

3. Indoor Air Quality

   Indoor air quality is an emerging environmental health problem that is attracting attention. The Pollution Study Group will continue to study the problem.

4. Grasshopper Spraying

   The Pollution Study Group was alarmed that the side effects of grasshopper spraying were not monitored. The group was effective in getting a Task Force established to monitor future spray programs and document the environmental impact of such an operation.

The Pollution Study Group held a Water Quality Workshop and dealt with a) Alberta's Water Policy, b) Alberta Government Water Quality Standards, and c) waste management enforcement as it affects water quality. The result of this workshop was an agreement between the Alberta Government and the City of Edmonton to undertake a study of the Edmonton water supply.

The theme of the 1985 Annual Joint Meeting was "Alberta Conservation Strategy." A draft prospectus was reviewed at the meeting. This program was endorsed by the membership at the annual meeting and the final draft is to be developed in 1986. The participation in this program by members of the Entomological Society of Alberta is encouraged and further information can be obtained from Mr. M. Kelly, Environment Council of Alberta, 8th Floor, Weber Center, 5555 Calgary Trail, Edmonton, Alberta, T6H 5P9 (Telephone: 427-5792, Zenith 06075).

J. A. Shemanchuk
ESA Representative

ACKNOWLEDGEMENTS

These proceedings would not have been possible without the cooperation of the individual authors, the executive members of the Entomological Society of Alberta, and our photographer, Dr. W. A. Nelson. Additional support, sincerely appreciated, was given by Agriculture Canada staff, namely Gayle Edwards, Linda Sears, John Kolpak, Ken Sinclair, and Nobby Nakahama. Last, but not least, appreciation is extended for the support and counsel of Paul Nezda, Robert Holmberg, and the University of Athabasca.

Thanks to all.

W. A. Charnetski
Editor

BY-LAWS

ENTOMOLOGICAL SOCIETY OF ALBERTA

Article 1

Title

This Society shall be known as the Entomological Society of Alberta in affiliation with the Entomological Society of Canada.

Article II

Object

The object of the Society shall be to foster the advancement, exchange, and dissemination of the knowledge of insects in relation to their importance in agriculture, horticulture, forestry, public health, industry and, for its own sake, among the people of the Province of Alberta.

Article III

Membership, Dues, and Expenditures

a. Any person interested in entomology may become a Full Member by submitting a completed membership application form and membership fee payment to the Secretary of the Society.

   Honorary Life Membership may be conferred on anyone who has performed long and distinguished service in the field of entomology. The total of Honorary Life Members shall not exceed five percent of the total membership at the time of election. An Honorary Life Member will enjoy all the rights and privileges of Full Members but will be exempt from payment of dues. All Full Members are entitled to propose the name of prospective Honorary Life Members provided each such proposal is supported by two other Full Members and documentation is submitted in writing to the Secretary at least one month prior to the Annual Meeting. Such Honorary Life Members will be elected at an Annual Meeting.

b. A member may withdraw from the Society upon giving notice to the Secretary.

c. An annual fee necessary for the operation of the Society shall be levied from each member as provided for in Section 1 of the Rules and Regulations.

d. The Executive shall have power to meet expenses required in the normal operation of Society business. Such expenditures shall be subject to subsequent ratification at the Annual Meeting by the majority of the members present.

e. A member who neglects to pay the annual fee for two consecutive years shall automatically cease to be a member.

Article IV

Meetings

Meetings may be called each year by the President at times and places suitable to the majority of the members. The fall meeting normally shall be considered the Annual Meeting and shall be held in the locality decided upon at the preceding Annual Meeting. One-quarter of the total paid-up membership shall constitute a quorum.

Article V

Officers

The Officers of the Society shall consist of a President, Vice-President, Secretary-Treasurer, and Editor. These officers shall constitute the Executive of the Society with full power to act on behalf of the Society within the bounds of the Rules and Regulations, and to appoint committees as necessary.

Article VI

Council

The Council shall consist of the four Officers, the immediate Past-President, a Regional Director to the Entomological Society of Canada, and three Ordinary Directors. The Ordinary Directors shall represent the various fields of entomology and the geographical areas of Alberta as widely as possible.

Article VII

Elections

Elections shall be held once a year at the Annual meeting, and Officers so elected shall take office at the beginning of the following calendar year and remain in office for a term of one year.

The office of President shall not formally be held by the same person for two consecutive years. The Vice-President shall normally follow his/her term of office with a term as President. The Secretary-Treasurer and Editor shall be eligible for immediate re-election.

The Directors shall also take office at the beginning of the calendar year following their election.

The Regional Director shall be elected for a period of three years and shall then be immediately re-eligible for one more term. The Regional Director's term expires at the end of the annual meeting of the Entomological Society of Canada.

The term of office of each Ordinary Director shall be three years, with one Director replaced in each year. Ordinary Directors are not immediately eligible for re-election.

Article VIII

Vacancies

Vacancies in any office (except that of President) on the Council between elections shall be filled by appointment by the President, with the concurrence of Council, the tenure of such co-opted members to terminate at the end of the calendar year during which the appointment is made. A vacancy in the office of President shall be filled by the Vice-President who will then serve his normal term as President.

Members elected at the Annual Meeting to fill vacancies on Council shall complete the period of service of the Council members whose places they have taken. On completion of this term they shall be eligible for re-election only if their period of service (co-opted and/or elected) has not exceeded 18 months.

Article IX

Duties of Officers

The President shall preside at all meetings and act ex-officio on all committees.

The Vice-President shall, in the temporary absence or disability of the President, perform the duties and exercise the powers of the President, and shall perform such other duties as shall from time to time be imposed upon the Vice-President by the Council.

The Secretary-Treasurer shall maintain a record of all meetings and act as custodian of minute books and current correspondence, and forward appropriate material to the University of Alberta for storage in the Society's archives. This person shall also receive and disburse all funds and prepare the annual financial statement.

The Editor shall receive and record reports and publications on behalf of the Society and act as editor of the Proceedings.

Article X

Signing Officers

The two signing officers of the Society shall be the President and the Secretary-Treasurer.

Article XI

Alteration of the By-Laws

The By-Laws may be altered or amended at any Annual Meeting of the Society with the approving vote of three-fourths of the members present and in good standing. Such alterations must be made by notice of motion, which shall have been sent to the Secretary and a copy of such forwarded to all members at least two weeks before the Annual Meeting.

November 3, 1985

RULES AND REGULATIONS - ENTOMOLOGICAL SOCIETY OF ALBERTA

1. a. The annual fee for full membership shall be $4.00.

   b. The fiscal year of the Society shall coincide with the calendar year; fees are payable in advance, at the time of the Annual Meeting.

2. a. An interim financial statement shall be presented by the Secretary- Treasurer at the Annual Meeting and the final, year-end statement at the first general meeting following the end of the fiscal year.

   b. Two auditors shall be appointed at each Annual Meeting to examine the accounts of the current year and the annual financial statement.

3. Registration fees for student members of the Entomological Society of Canada attending the Entomological Society of Canada meetings shall be reduced when these meetings are held in Alberta with the Entomological Society of Alberta as host.

4. The following standing committees shall exist to assist the ESA Council achieve the objectives of the Society:-

   a. Awards Committee - members: Past President, Regional Director to ESC, and the Regional Directors of the ESA. Duties are to solicit and generate nominations of the Entomological Society of Alberta members for Entomological Society of Canada awards (e.g., Gold Medal, Gordon Hewitt, Norman Criddell) and Entomological Society of Alberta awards (e.g., Honorary Membership, student prizes).

   b. Environment Council of Alberta - one ESA member shall be elected to represent the Society.

   c. ESA-ESC Joint Meeting Committee - to be established a year preceeding any joint meeting of the Entomological Society of Canada and the Society; members to be selected from Society membership.

   d. Insect Collection Competition Committee - members: one elected member plus two other members appointed by the elected member at each Annual Meeting of the Society.

   e. Nomination Committee - members: the Past President, Vice-President, and one member in good standing shall prepare a nomination slate prior to each Annual Meeting and the Vice-President shall present the slate of nominated Executive Council members at the Annual Meeting.

   f. Resolutions Committee - members: two Society members shall be appointed immediately preceding each Annual Meeting.

   g. Science Fair Liaison Committee - members: one elected Society member; other members to be appointed as necessary by the elected member.

   All elections and appointments are not to exceed one year unless otherwise approved by the Society.

5. The Rules and Regulations may be changed by a motion approved by the majority of the members present at any general meeting.

November 3, 1985

LIST OF MEMBERS

(Revised May 1986)

Honorary Members

Mr. J. B. Gurba
9415 - 144 Street
EDMONTON, AB
T5R 0RB

Mr. E. T. Gushul
1714 - 15 Avenue South
LETHBRIDGE, AB
T1K 0W9

Mr. L. A. Jacobson
1011 - 14 Street South
LETHBRIDGE, AB
T1H 2W3

Dr. Ruby I. Larson
2503 - 12 Avenue South
LETHBRIDGE, AB
T1K 0P4

Dr. W. A. Nelson
1020 Fern Crescent
LETHBRIDGE, AB
T1K 2W3

Members

Mr. John Acorn
Department of Entomology
University of Alberta
EDMONTON, AB
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Mr. Robert Anderson
Department of Entomology
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WANTED!

ALIVE OR DEAD

Specimens of Solpugida (Arthropoda: Arachnida) for Scientific Study

Also known as: Sun-spiders and Wind-scorpions

Size: 2-3 centimetres (1 inch) as adults

Colour: Tan

Habitat: Dry regions of southern British Columbia, Alberta, Saskatchewan and, perhaps, Manitoba.

Habits: Nocturnal predator; very fast and agile; found under rocks and "cow pies" but also in garages and other buildings.

Other remarks: Non-poisonous but may attempt to bite; rare but previously collected in the southern Okanagan valley, and around Lethbridge, Medicine Hat and Swift Current; there may be up to six species (kinds) in Canada; if sent alive they should be packed with some moist paper towelling; best preserved in 70 to 75% ethanol (grain alcohol), 60% isopropyl (rubbing) alcohol, or 4% formaldehyde (they shrivel too much if pinned like insects).

If you find this animal, please send it to: Dr. Robert Holmberg, Sciences, Athabasca University, Box 10 000, Athabasca, Alberta, T0G 2R0
Telephone: (403) 675-6226 or 1-800-282-3901