

Following graduate studies at Illinois he accepted a post as assistant professor at the University of British Columbia. Twenty-nine years later — having risen through the ranks — he retired and is now Emeritus Professor of Zoology and Honorary Curator of the Insect Collections.

Throughout our speaker's distinguished career, his interests have been broad with some emphasis, perhaps, on certain economic aspects, such as — the biology of range grasshoppers and their parasite complex and also the ectoparasites of birds and mammals.

During the 29 active years at U.B.C. and also while at Guelph, he endeared himself to many students. At O.A.C. the students referred to him respectfully, affectionately and "behind his back", as "Bugs". As is true of all outstanding teachers, our speaker is a restrained extrovert who punctuates his lectures with demonstrations — acting out insect behaviour in a vivid manner. One of his former students has told me about the demonstration he witnessed of the mating dance of the Dolichopodidae; he said "I shall never forget it as long as I live."

I wish that there was time for it this morning, sir. Many of us here are woefully ignorant about this biological phenomenon.

Ladies and gentlemen — the Historical Address — Professor George J. Spencer.

A Century of Entomology in Canada

By G. J. SPENCER

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Mr. Chairman,

Mr. President of the Entomological Society of Canada,

Mr. President of the Entomological Society of Ontario,

Ladies and Gentlemen,

I am fully and deeply appreciative of the honour that the Entomological Centennial Committee has done me in asking me to give a brief history of 100 years of Entomology in Canada, and I feel that it would be fitting if the address was modelled after a sermon, taking as a text the oft-repeated sentences in the Book of Kings in the Old Testament of the Bible: "Now of the acts of Jeroboam and Jehu and Ahaz and all that they did, are they not written in the Chronicles of the Kings of Judah and of Israel?"

Equally justifiably might I say now,

"So of the Founders of the Entomological Society of Canada and their deeds and their writings of early history and the scientists who built up the organization and of the Journal that they founded and of the changes of policy that they made and of how entomologists multiplied and waxed strong even unto this day, Lo! are they not written in the words of C. J. S. Bethune¹ and of W. E. Saunders,² of A. W. Baker,³ of John Dearness⁴ and of Robert Glen,⁵ of G. A. Moore⁶ and J. H. McLeod,⁷ of Arthur Gibson⁸ and of many others, in the *Canadian Entomologist*, the Annual Report (and Proceedings) of the Entomological Societies of British Columbia⁹ and of Ontario,¹⁰ the *Entomology Newsletter* and other volumes?"^{11,12,13}

Also, in addition to all that has been written about entomology in Canada, its growth and development, there are several sources of photographs of individual

men and of groups of men; history and portraits are available to those who want to refer to them especially the priceless exhibit of historical photographs arranged by Messrs. W. E. Heming, C. D. F. Miller and G. S. Walley in Room 393 of the Tory (Science) Building on this campus; most of the men shown have passed on and their portraits mean little to the present generation; however, in keeping with the mood of the past, I shall later show you a few scientists present here now, as they were years ago before they became famous. So, one can only skim the surface, touch a name and a date here and there, run the risk of offending many deserving people by omitting their names and achievements, and include a few anecdotes in place of a detailed historical account. At the outset, may I beg forgiveness from so many deserving men and women whose names have perforce been omitted from this account.

To paraphrase and summarize, in my poor halting style, the writings of these men and of many others whose records have given us all the required information in beautifully expressed sentences and succinct style, would surely be a redundancy; scores of dates and hundreds of names of men and of thousands of names of insects retailed paragraph by paragraph would be boring in the extreme; it would only be a fitting anaesthetic to close out the dying moments of the last century of entomology and certainly no way to usher in the new one. Heaven forbid that I should put you to sleep so soon in this Centennial celebration!

In 1863 and 1864, two immensely important societies were formed; the Red Cross by Henri Dunant, a Swiss businessman, for saving life around the world, and the Entomological Society of Canada by a theological student, which for 100 years has resulted in taking the lives of countless millions of native Canadian insects and of immigrant insects from other parts of the world.^{14,15}

Entomology in Canada began in 1863¹⁶ with a small but able and well educated group of naturalists who were interested in entomology in what was then the Province of Canada, a temporary union of Ontario and Quebec. Most of the country was still covered with forest, but agriculture and lumbering were already thriving and featured the export of wheat and white pine. Little was known about insects except by correspondence with people overseas. There were no named reference collections and few available books on the subject. Outlets for publication were few but much stimulus resulted from two publications in which early entomological literature was found: *The Canadian Journal* (Toronto, 1852) and *The Canadian Naturalist and Geologist* (Montreal, 1856). Among early contributors were C. J. S. Bethune of Toronto and William Saunders, a druggist of London, Ontario.

Now damage to wheat crops by the Hessian fly (*Phytophaga destructor* (Say)) and the wheat midge (*Sitodiplosis mosellana* (Gehin)) occurred periodically and destruction in 1856 in Ontario alone was estimated at two million dollars. The Bureau of Agriculture and Statistics of the then Province of Canada offered prizes on the subject and the first prize of £40 was won by H. Y. Hind, Professor of Chemistry at Trinity College, Toronto for his "Essay on the Insects and Diseases Injurious to the Wheat Crops". To prepare this essay, Hind read extensively the work of entomologists in the United States, Harris, Fitch, Curtis, and Killar and older European authors.¹⁷

Also in 1857, l'Abbé Léon Provancher listed eight pest species attacking wheat crops in Canada East (Quebec).

With these two articles our economic literature began and greatly stimulated interest in entomology.¹⁸

On 26 September 1862, a theological student in Toronto, C. J. S. Bethune, who later (1906) became head of the Department of Entomology and Zoology at the Ontario Agricultural College, and William Saunders, a druggist of London, Canada West, arranged the first meeting of entomologists ever held in Canada. At the home of Professor Henry H. Croft in Toronto, ten men met to form an entomological society and draft its objectives. However, it was not until 16 April 1863 that the Entomological Society of Canada was organized with headquarters in Toronto, with a membership of 25.¹⁹

In connection with this origin and growth of entomology in Canada, Bethune and Saunders are worthy of further consideration. Charles J. S. Bethune^{20,21,22} was born in 1838, son and grandson of Bishops of the Anglican Church in Toronto; he was "head boy" of Upper Canada College at 18, B. A. with first class honours in classics and mathematics, Jubilee Scholar and Wellington Scholar at 21, M. A. and ordained deacon of the church at 23, priest at 24 and after holding several church incumbencies, he became headmaster of Trinity College School, Port Hope, at 32 years of age, a position he held for 29 years during which the school progressed in buildings and standards, to a high degree. He was the first editor of the *Canadian Entomologist* from 1868 to 73, and again from 1886 to 1909, and President of the Society from 1870 to 1878; he was made a Doctor of Civil Laws in 1883 and a Fellow of the Royal Society of Canada in 1892; he was a Fellow of the A.A.A.S. and of the Entomological Society of America, a corresponding member of nine international scientific societies besides holding many high offices in the church, one being the honorary clerical secretary of the General Synod of the Anglican Church in Canada. In 1906 he accepted the chair of Entomology and Zoology at the Ontario Agricultural College and retired after 14 years, in 1920.

I took some course work with Dr. Bethune and was closely connected with him when he suffered from cataract and was operated on first one eye and then the other. For a year during his blindness I was his amanuensis and attended to all his mail and odd departmental duties. He had a prodigious memory for references to literature, entomological history and scientific names. He always spoke in a soft, gentle voice and students in a big classroom seldom heard what he was saying. One may gauge the character of the man from an incident that happened when I was curator of the Society's collections and was working over a cabinet of tropical butterflies. At that time I was impressed with the opportunities of earning a living as an economic entomologist and drawers full of exotic butterflies did not appeal to me. I remarked to him, "Dr. Bethune, why do you suppose these butterflies were created? They occur in the tropics where nobody pays any attention to them and they don't seem to be of any use to mankind." He replied, "Spencer, I suppose they were created because the Lord has an eye for the beautiful."

For such a scholarly, kindly and gentle old man, Dr. Bethune had three rather surprising pet aversions: one was the Salvation Army which once apparently refused to help someone that he sent to them; the second was Cardinal Merry del Val for reasons which I did not comprehend and the third was almost any man from northern United States whom the good doctor described in staccato tones as "a Yankee." Now Dr. Bethune had some very close American friends and it was surprising to hear him speak of Northerners in this way. It is still more remarkable when we recollect that the Entomological Society which he was so instrumental in founding, keenly recognized the material aid and encouragement received from Americans and very early in its history made them Honorary Members of the Entomological Society of Ontario as shown on the following list with the date of their election.²³

Members	Date Elected
(Francis Walker, England	Feb. 1865)
E. T. Cresson, Philadelphia, Pa.	Nov. 1865
W. H. Edwards, West Virginia	Nov. 1865
Prof. Townsend Glover, Washington, D.C.	Nov. 1865
Augustus R. Grote, New York	Nov. 1865
Dr. George H. Horn, Philadelphia, Pa.	Nov. 1865
Dr. A. S. Packard, Salem, Mass.	Nov. 1865
C. V. Riley, St. Louis, Mo.	Nov. 1865
S. H. Scudder, Boston, Mass.	Nov. 1865
Benj. D. Walsh, Rock Island, Ill.	Nov. 1865
Baron R. von Osten Sacken, New York	Sept. 1869
Dr. Herman Hagen, M. C. Z., Cambridge, Mass.	Sept. 1869
Dr. Asa Fitch, State Ent., New York	Sept. 1869
P. R. Uhler, Baltimore, Md.	Sept. 1873
V. T. Chambers, Covington, Ky.	Sept. 1873

It was not until years afterwards that I discovered a possible reason for this dislike; he was the grandson of John Bethune who was born on the island of Skye, Scotland, educated in King's College, Aberdeen, migrated to South Carolina and was Chaplain to the 84th regiment of Royal Highland Emigrants during the War of Independence; his sympathies with and for the Southern Colonies, later to become the Confederate States, were apparently inherited by his grandson Charles—hence his scorn of "Yankees"—spoken of, however, without an adjective!

The last time I saw Charles Bethune was in the garden of his house in Toronto when he was in his 91st year and getting a bit feeble, but his mind was still active and he discussed at some length an article he had just read in the current number of *Science*. He was a great smoker and when he stopped smoking a pipe, he gave me his terra-cotta tobacco jar; it is fitting that it should continue in sound entomological hands, for I gave it to George Holland who uses it to this day.

Dr. Bethune's collaborator was William Saunders, who was born in Devonshire, England in 1835, and came to Canada in 1847, trained as a chemist and became a retail and then wholesale druggist in London, Ontario.¹⁴²⁵

William Saunders was then the moving spirit of the Entomological Society in that city and influenced many men of different vocations to take up the study of insects for interest's sake. He was a pharmacist and chemist whose hobby was horticulture and he practised on a farm of 75 acres which he intended for fruit but later discarded it for a plot of six acres designed for experimental purposes, to develop ideal fruit bearers. Here he encountered pests of fruit trees which he studied assiduously giving him the background for the book he published in 1883 *Insects Injurious to Fruits*, which was the standard text on the subject in North America for 25 years. His experience with these experimental trees and their insect enemies prepared him for the position of Director of Experimental Farms to which he was appointed in 1886; he moved to Ottawa and for 25 years he guided and developed this work. He belonged to many scientific societies and received many honours, being one of the original members of the Royal Society of Canada; he was the recipient of honorary degrees from Toronto and Queen's Universities and in 1905 was made a Companion of the Order of St. Michael and St. George. He retired in 1911 and died at his old home in London in 1914.

The formation of a Society led immediately to an increase in the publications on insects; so the Society established its own journal, *The Canadian Entomologist*. Systematic entomology received a further impetus when l'Abbé Léon Provancher founded the periodical *Le Naturaliste Canadien* in 1868 and between 1877 and 1890



Fig. 4. James Fletcher, first Dominion Entomologist and Botanist, 1884-1908.

published three volumes and several supplements of *Petite Faune Entomologique du Canada*.²⁸

Apart from the activities of the Entomological Society of Ontario and the publication of the *Canadian Entomologist*, Canadians did not have to exert themselves much in insect control because their insect problems closely paralleled those of the United States which had greater facilities for research in control and much earlier Federal legislation, and appropriations and results of research were generously and at once made available to Canada.²⁹

Public support³⁰ for economic entomology in Canada began in 1870-71 when the legislature of the Province of Ontario incorporated the Entomological Society of Ontario and gave it, for the year 1870, a grant of \$400 on condition that it furnish an annual report on noxious insects, provide the association with a cabinet of insects and continue to publish its journal. These conditions³¹ were accepted and the Annual Report for 1870 featuring insects affecting the apple, the grape and the plum was published in 1871 and its articles by very able pioneer naturalists were invaluable sources of practical information for the farmer, orchardist and gardener of early Canada. In fact, the Ontario society continued to function essentially as a national organization with branches in several other provinces, preserving a national viewpoint until the Entomological Society of Canada was re-established in 1950.

Now in 1884, the Department of Agriculture of Canada established the office of Honorary Entomologist and filled it by the appointment of Mr. James Fletcher³⁰ an employee of the government library at Ottawa and already widely known in

entomological circles. Fletcher was born in Ash, Kent, England in 1852, educated at King's School, Rochester and at 19 years of age joined the Bank of British North America and at 22 years of age he was transferred to Canada and stationed in Montreal where he worked for two years until May 1876 when he went to work in the Library of Parliament. Here he was free from ledgers and account books with time and freedom to devote to his hobbies, botany and entomology. Shortly afterwards he was appointed in the Department of Agriculture, to the recently organized Dominion Experimental Farms where he worked until his death in 1908.

His knowledge of insects injurious to crops was very extensive and by his able lectures and publications he made people familiar with insects, their ravages and their control. He was a witty, forceful and pleasing speaker and addressed meetings from coast to coast of Canada where his intense interest in plants and insects and his charming manner of speaking about them endeared him to everyone who met him. His executive ability was of a very high order and his personal influence and competence so great that the necessity for additional funds for entomological research was overlooked by government—the peoples were so satisfied with Fletcher and what he was doing.^{31,32} His ability was early recognized; at only the third meeting of the Royal Society of Canada he was elected a Fellow; he was also a Fellow of the Linnean Society of London, President of the Entomological Society of Ontario and later of the Royal Society of Canada; a member of the Entomological Society of America, founder in 1879 and always a keen supporter of the Ottawa Field-Naturalists' Club and, when in Washington, D.C. he and Dr. L. O. Howard drafted the original constitution of the American Association of Economic Entomologists which was effected in fact at Toronto in 1889. Finally, he was awarded an honorary LL.D. by Queen's University, Kingston, in 1906.

With the enormous development of Canadian agriculture, Fletcher's reports constantly improved and his 24 Reports provide a monumental record of developing economic entomology. He was also responsible for the San José Scale Act of 1898, the first Federal legislation on noxious insects. He died in 1908, following an operation.

So great was the influence of Fletcher and so strong his charming personality that the appointment of his successor was considered a difficult and serious matter. Finally, the authorities went outside the continent altogether and appointed a young man from Manchester University, C. Gordon Hewitt, who had just published a monograph on the house fly.³³

After Fletcher's death, a relatively young man, Arthur Gibson, who had been Fletcher's assistant, was temporarily appointed as Entomologist until Hewitt's arrival. Hewitt arrived unannounced, presented himself at the room shown him as that of the entomologist and announced "I am Gordon Hewitt." As Hewitt himself described it, the entomological service consisted of one room, one man, one table and one chair. Gibson greeted him and said, "Just a moment, Dr. Hewitt, while I fetch another chair."

With the appointment in 1908 of Hewitt, a university-trained Doctor of Science in zoology and entomology, as Dominion Entomologist, the era of naturalists and hobbyists in entomology in Canada came to an end and a new phase began. Great names such as Bethune, William Saunders, Baynes Reed, Professor Croft, A. F. Winn, Rev. T. W. Fyles, J. Fletcher, naturalists in the true sense of the word, highly educated men and lovers of nature, passed over and a new type of professional entomology came into being.^{34,35}

This passing of the amateur entomologist is deplorable. The founders of this Society were all amateurs, the 19-year old divinity student Bethune, his friend,

young Saunders and Professor Croft; so were Dr. Fyles, Fletcher, Arthur Gibson himself, the whole Criddle family in Manitoba, especially Norman who did such valuable work on grasshoppers on the Criddle farm and at the laboratory at Treesbank; Edmund Walker, who qualified as a medical man, whose monographs on *Aeschna* and *Somatochlora* were declared by the reviewer in the *Annals* as "models of their kind for all time to come"; Wallis of Manitoba and Carr of Alberta, coleopterists whose work lives after them and, in British Columbia, Ralph Hopping who had the largest private beetle collection in Canada, Whitehouse the odonatist, Blackmore the lepidopterist, Downes the hemipterist and finally Mrs. Hippisley Clark whose beetle records of the Terrace, B.C. area are reported by the leading coleopterist of the Pacific Northwest, Professor M. Hatch of the University of Washington, to have been "the largest by 150 species of any area in the Pacific Northwest." Probably W. Downes and Wallis were the last great amateurs in Canada. There is only one now in British Columbia, a medical man, Dr. W. Lazorko of Vancouver, who escaped from the Ukraine with a few hundred thousand beetles in papers, leaving behind thousands of pinned specimens; his mounted arranged collection is probably the neatest in Canada. I know of only one boy in Vancouver, just entering his teens, who is an ardent entomologist and he will unfortunately probably become a professional.

Certainly as far as British Columbia is concerned and probably elsewhere across Canada, there are too many distractions and other fields of interest from the standpoint of both parents and children, to encourage an amateur naturalist and entomologist. Around Vancouver there are available to youth, sports cars, three kinds of football, baseball, lacrosse, tennis every month of the year, marine and freshwater swimming, water-skiing, skating and snow-skiing the year round and there is no example and enthusiasm, no leadership among the teachers themselves.

This is a deplorable situation because as you all know, there is so much pleasure to be had in entomology, unless one becomes part of a production machine, forced to punch a time-clock and not allowed to come back to the building at night. There is so much prescribed work in modern entomology that there is little attraction in having a sideline as a hobby. And yet, in spite of his arduous administrative duties during the day, George Holland finds relaxation in working over fleas with a microscope at night. There is hope for others too!!

Returning to Hewitt and the start of the new type of entomology, at first he created an unfavourable impression. He was reserved, stiff in his attitude and seemed somewhat conceited and diffident — such a marked contrast to his predecessor, the amiable and genial Fletcher. But opinions soon changed for Hewitt showed himself a sound thinker and a great organizer with a remarkable ability for picking the right men for responsible positions. When Professor C. H. O'Donoghue of the Department of Zoology at the University of Manitoba, asked him "How much entomology do you want us to teach our students?" Hewitt replied "Only as much as is consistent with the other classes of the Arthropods in the basic course of zoology; when we employ your graduates we will give them all the further entomology they need."

Within a year of his appointment and under his leadership, the important Destructive Insect and Pest Act was passed in 1910, an Act which to this day can be modified by regulations by order-in-council to suit any conditions which may arise to prevent the introduction and spread of noxious insects, plant diseases and other agricultural pests in Canada. This Act required funds for maintenance and putting into force; so Hewitt was able to establish 12 small laboratories in all provinces except Prince Edward Island with trained men in charge; he stepped up



Fig. 5. Dominion Entomologists 1909-1950 and Chiefs of the Entomology Division 1950-59. Top row, C. Gordon Hewitt, 1909-20; Arthur Gibson, 1920-42. Middle row, L. S. McLaine, 1942-43; H. G. Crawford, 1943-50. Bottom row, R. Glen, 1950-57; B. N. Smallman, 1957-59.

the importance of Forest Entomology and put J. M. Swaine in charge; he separated entomology from the Experimental Farms Branch and made it a distinct Entomological Branch which he organized into four distinct divisions – Field Crop and Garden Insects, Forest Insects, Foreign Pests Suppression with strategically placed quarantine inspection stations, and Systematic Entomology. These advances at Federal level stimulated parallel developments in the Province which soon appointed Provincial Entomologists: – In Ontario, L. Caesar whose biography I shall give you shortly; in Quebec, Canon V. A. Huard; in British Columbia, W. H. Brittain and in Nova Scotia, Robert Matheson; the Provinces also increased their staffs in entomology in several agricultural colleges and at least in British Columbia, stimulated the founding of a journal, *The Proceedings of the Entomological Society of British Columbia*, which to this day has continued to publish annually.

Unfortunately, the world-wide influenza epidemic struck Hewitt and he died on 29 February 1920, of pleural pneumonia, without being able to develop to the fullest extent his broad plans for advancement. Apart from the building up of the Dominion Entomological Branch, he and his work were highly thought of in the United States: he was President of the American Association of Economic Entomologists in 1916 and in the same year was appointed Consulting Zoologist to the Canadian Government; he was Canadian representative on the International Commission for the Protection of Nature and drafted the very important Migratory Bird Treaty which came into force later on. His book *The Conservation of the Wild Life of Canada* was completed before he died and was published posthumously by his wife, Elizabeth Hewitt.

The broad foundation that Hewitt left was accepted and greatly expanded by each in turn of his successors: Arthur Gibson (1920-1942);³⁶ Leonard S. McLaine (1942-1943);³⁷ H. G. Crawford (1943-1950); Robert Glen (1950-1957)³⁸ who was soon to be made Director General of the Research Branch; and then by B. N. Smallman who has just resigned to become head of the Department of Biology at Queen's University.

Now a few words about the first Provincial Entomologist for Ontario, Lawson Caesar. In the development of economic entomology in Ontario, if not in the whole of Canada, his name stands out pre-eminently.^{39, 40} Caesar virtually lived to help his fellow men, not only every type of farmer and householder but everybody who had any kind of insect troubles, and he trained a generation of students in the fundamentals of insect control, many of whom as District Agriculturists in their turn, helped growers not only in Ontario but across Canada, and even in other countries to which they went in agricultural executive positions. Caesar never sought the limelight and never exalted himself; consequently he is less known than those who achieved far less in insect control than he did.

Caesar's family was of English stock who migrated to Ireland at the end of the 17th century and his great-grandfather John Caesar came to Canada from Tipperary in 1824 and settled on a farm at Mono Road some 14 miles north of Brampton, Ontario, where Lawson was born. He attended high school at Brampton, walking the 14 miles from and to his home every week-end to save expenses, and then went on to a B.A. degree at Toronto University in 1895 getting first class honours in classics every year of his course. After teaching in high school for a few years in Ontario he spent one year at Oxford University, then toured England and Scotland extensively and returned to Canada, taught for four years at Port Hope School and then took the four-year degree course at the Ontario Agricultural College in three years and was appointed to the staff as Demonstrator on Insect Pests and Plant Diseases, then Lecturer and then Professor of Economic Entomology and Provincial Entomologist. Some of the problems he attacked and solved were black rot cankers of apple, peach yellows and little peach, the

apple maggot, San José scale, cherry fruit fly, and household pests of all kinds. In addition he trained and supervised as many as 80 fruit and insect inspectors, training farmers in correct spraying methods and drawing up spray calendars, and published some 14 bulletins on economic insects and *A History of Spraying in Ontario*.

Lawson Caesar was a deeply religious man, the soul of integrity, absolutely honest and faithful in his duty, and he devoted his life to helping his fellow men. I once asked him "By what rule do you govern yourself in your difficult administrative and supervisory work?" and he replied "I simply ask myself 'What would Jesus Christ do under these trying circumstances?'" and the knowledge of right and wrong being deeply ingrained in him, he never deviated from the right course. After retiring from the position of Provincial Entomologist in 1940 he toured Canada and then settled down in Guelph. Just after recovering from virus pneumonia, he died suddenly on 27 April 1952 from a heart attack.

Returning to Federal Entomology:— On 1 April 1937, Dr. J. M. Swaine⁴¹ was appointed Director of Science Service with five Divisions of which Entomology was one, and several new laboratories were built with increased staff to man them. But war intervened, and the whole Service was put on a purely maintenance basis. Then in 1945 Swaine retired and was succeeded by Kenneth W. Neatby from Winnipeg.⁴²

Outstanding in the reorganization of science research administration in the Department of Agriculture was this giant, Kenneth Neatby. Born in Surrey, England in 1900, he was brought to Saskatchewan in 1906 by his parents, was educated at home and then at the University of Saskatchewan up to the Master's degree level, obtained a doctorate from Minnesota, did research in many phases of plant science, taught at the University for five years, published extensively, was active as Director in administration research and extension work with the Line Elevators Farm Service in Winnipeg and, in 1946 became Director of Science Service, Canada Department of Agriculture. Here he produced terrific innovations and expansions in reorganization, administration, increases in personnel, research laboratories and facilities: he more than tripled the annual budget, from less than three to more than ten million dollars, and integrated or consolidated science laboratories. As for the need for this integration, I quote from Dr. Defries:⁴³

"Year by year it is becoming increasingly difficult for *individual* workers in universities and in scientific institutions to make satisfactory progress in the study of complex research problems: such investigations need to be conducted in institutions where there are groups of scientific workers with special training in various fields."

That Neatby's plan succeeded may be judged from the Report of the United Kingdom Mission which toured Canada from June to August 1950, under Sir William Ogg, and I quote:⁴⁴

"The Science Service of the Federal Government is attempting to fill, and with very great success, the growing need for more fundamental research into the agricultural sciences not necessarily closely related to the solution of immediate practical problems . . . as has been done in Britain and in other countries on which Canada has relied for so long. To be pursued really effectively and adequately, research should be free of any other compelling calls."

Among his innovations that later became standard departmental practice was an arrangement with the National Research Council for a number (four) of post-doctorate fellowships tenable at selected departmental laboratories.⁴⁵

Now contrast this plan with the holding of a post-doctorate fellowship at a university. In this case a man with a bright idea has partly achieved his object, has picked up a doctor's degree on the way, selects a university with adequate

equipment where he can work under or with a noted scientist, brilliant in the same line, and then settles down to work out his bright idea.

Neatby's plan, it seems to me, is especially valuable to scientists outside of Canada who wish to gain experience by coming to this country and working in a research laboratory where several men, specialists in several disciplines, are attacking different phases of one problem and are pooling their efforts towards the solution of this problem. To a man who has not had this experience, working with these specialists would indeed be a boon.

Neatby, however, did not confine himself only to work at headquarters; he travelled from coast to coast keeping track of all laboratories. The first time he came to British Columbia he wrote to Ronald Buckell who was in charge at Kamloops saying that he would be in Calgary on a certain date and since Kamloops was only 400 miles away he would leave early in the morning and arrive by car in late afternoon. Now Dick Painter has for years described British Columbia roads as "narrow trails hanging on to the sides of steep mountains"; so Buckell wired Neatby to allow two days for the journey, which he did, and arrived one afternoon at the laboratory where he remained with the two entomologists until ten o'clock at night, when he met Buckell at a restaurant in town for a very late dinner. He told Buckell "I have spent the last three weeks visiting laboratories across Canada and I have had more fun here with these two enthusiastic young chaps than in any other spot since I left Ottawa."

One of those young chaps, Jack Gregson, is now Director of the laboratory at Kamloops for research on insects affecting man and domestic animals and is also Canada's authority on ticks — and the other is Chairman of these Centennial meetings. Dr. Neatby knew how to pick men.

Now shortly before another of Neatby's visits to British Columbia, this time to inspect especially the Research Branch's warfare against forest insects, the research officer in charge in B.C. had applied to Ottawa for permission to purchase ten pairs of loggers boots with calks on the soles for the use of temporary summer employees, since the cost of \$18 to \$30 apiece was too much to ask of young men who would be only four months on the job. Neatby turned down the request, flat. Later, when he came west and during his inspection of the insect outbreak in the forests, the party working there under two Science Service men, had to traverse rough country and came to a narrow, deep gorge spanned by a tree felled across it to function as a bridge. The two leaders wearing calked boots nonchalantly walked across and waited for Dr. Neatby and his companion from Ottawa. Now the Director was a very tall man of 6 ft. 7 in., the log bridge was narrow and the canyon uncomfortably deep, so after only two steps, the Chief and his helper straddled the log and pulled themselves across, bump by bump, to be gravely hauled up by the local men while nine or ten assistants crossed over the log behind them. The last man had a camera and unknown to Neatby took a full series of photographs of the undignified crossing of the two Chiefs.

Shortly after his return to Ottawa, Neatby received a set of 8 x 10 in. enlargements of every stage of his frog-hopping crossing, without comment, and such was the bigness of the man in every way that the research officer in charge in British Columbia shortly afterwards received a telegram of three words only: "BLACKMAIL. BOOTS AUTHORIZED."

When war ceased in 1947 Neatby appointed Colonel W. E. van Steenburgh⁴⁶ who had just returned from Europe, as Research Advisor to the Director. Now van Steenburgh had risen through the entomological ranks in laboratories in southwest Ontario but he enlisted soon after war was declared, and finished up in charge of Canadian artillery. He had outstanding administrative ability and when reappointed to the Science Service, he planned the details of the consolidated laboratories that Neatby had in mind, combining the facilities of all five Divisions



Fig. 6. Top, Prof. G. J. Spencer's entomology class of 1934, University of British Columbia; Igor Kosin (standing), G. P. Holland, Morley Neal and the late Kenneth Jacob. Bottom left, "BLACKMAIL. BOOTS AUTHORIZED." (R. E. Foster standing, the late K. W. Neatby and K. M. King seated). Bottom right, H. H. Ross and John Stanley (1927), Prof. Spencer's first graduates in entomology.

so that entomologists, plant pathologists, plant physiologists, plant breeders and geneticists, chemists (and a trained photographer) could combine their training and experience in tackling all problems that might arise, and in doing pure research. With variations such as virus experts, meteorologists, ecologists and the occasional taxonomist, this type of Science Laboratory was spread across Canada at strategic locations, and a golden age in entomological research was begun.^{47, 48, 49, 50}

These two Divisions serve to illustrate similar advances in other phases of entomological research, namely:

1. The Plant Protection Division built up by W. N. Keenan, now retired, which is responsible for all inspections of foreign imports for plant diseases, insect pests and nematodes, and for potato surveys and import permits.
2. The Forest Biology Division under J. J. de Gryse, responsible for forest zoology, forest pathology, forest insect survey, chemical control and insect toxicology.
3. The Insect Pathology Research Institute at Sault Ste. Marie under J. W. McB. Cameron with a staff of ten scientists responsible for insect viruses, entomogenous fungi, bacteria and protozoa, and serological and physiological studies.
4. The Pesticide Research Institute at London, Ontario, under H. Martin (now retired) with a staff of 21 scientists responsible for insect physiology, toxicology, all phases of chemistry, biochemistry, fumigation and plant physiology.

In addition to these there are Regional Research stations and Laboratories from Nova Scotia to Victoria, B.C. with large staffs of scientists responsible for all phases of coordinated research in entomology, plant sciences, bacteriology, soils and chemistry. Periodically, all these stations and sub-laboratories put out scientific reports in entomology similar to the monographs and family or generic revisions of the Entomology Research Institute. The publications of the Forest Entomology and Pathology Branches under R. F. Morris and R. R. Lejeune are outstanding examples of population dynamics and forest insect and disease surveys.⁵¹

There were continuous changes in personnel as men retired or were transferred: Dr. Gibson retired in 1942 and was succeeded by L. S. McLaine who tragically died a year later and was succeeded by H. G. Crawford who resigned in 1950 in favour of a much younger man, Robert Glen. In 1957 van Steenburgh resigned as Associate Director of Science Service and Glen succeeded him, and B. N. Smallman from the London Laboratory then became Chief.

These few names mentioned are examples of the continuous changes that occurred after World War II in the Science Service when men were promoted as those above them retired when they reached the age limit or resigned the services to enter other lines of work; the most recent of such changes being the resignation of Dr. B. N. Smallman, to become Head of the Department of Biology at Queen's University.

The Library of the Entomological Society of Ontario

The Library of the Entomological Society of Ontario, developed with the cooperation of the Entomological Society of Canada, is very adequately housed in the new Biology building of the Ontario Agricultural College. It is under the care of the librarian, W. C. Allan, who keeps the books and journals fully catalogued and up-to-date. It contains some 7,700 books and 1,650 bound volumes of periodicals which are being added to at the rate of 90 to 100 volumes

per year, largely in exchange for the *Canadian Entomologist*. Since the library has been in existence from the time of the Society's formation, many of the books are very old and valuable. All are available through the Library Exchange Service. I am indebted to W. C. Allan for this up-to-the-minute information.

The Canadian National Collection of Insects^{502, 53}

One phase of this rapid and tremendous growth needs special mention. When Hewitt in 1914 separated the Division of Entomology from the Experimental Farms Branch to become the Entomological Branch, the Farm's collection of insects was joined to that of the National museum to form the National Collection, with the Dominion Entomologist as Honorary Curator. In 1919, Dr. J. H. McDunnough, an outstanding systematist from the United States, was placed in charge with one technician, Miss G. Beaulieu, to assist him. For some years following, men from laboratories in the Provinces who were interested in systematics spent the winters in Ottawa identifying and arranging the collections. Gradually, trained systematists such as Howard Curran, dipterist and H. L. Viereck, hymenopterist, were appointed for some years to be followed by G. S. Walley, hemipterist; W. J. Brown coleopterist, O. Peck, a chalcid specialist, and T. N. Freeman, lepidopterist, men who are still actively working.

Dr. McDunnough retired as head of Systematic Entomology in 1946 and in 1948 G. P. Holland from Kamloops was appointed Head. Holland has increased his staff to 23 full-time taxonomists with supporting staff, and has widened the scope of the collections to include insects from North America other than Canada; and a beginning is being made to include those from other countries, to make the collection international.

Now Canada owes an enormous and hitherto completely unrealized and unacknowledged debt to Japan and to the Soviet Union in connection with the building up of the National Collection. During World War II many American troops were stationed in Alaska and, in regions of swift streams, blackflies emerged in millions and in flat marshy regions, mosquitoes in billions, which fell upon the full-blooded troops so that the men refused to move out from their shelters. The cry went up for volunteers to test out repellents against all types of biting flies and even from the field laboratory at Kamloops the unsung heroes Gregson and Holland submitted themselves to tests in those parts of the interior of the province where mosquitoes prevail. There are available photographs showing the limbs of these men, swollen to twice normal size when the repellents they were testing failed to repel. But large numbers of all species of biting flies were collected and identified and added to museums by these men.

Then after the war, when the Soviet Union and the United States snarled at each other over Canada's shoulder and North America feared high-flying bombers coming in over the North Pole, there were established two parallel, far flung Early Warning lines of posts stretching across the top of the continent, manned by men of both nations, to give at most twenty minutes warning in case of attack. Now in northern regions there are relatively few species of blood-sucking flies but numbers of each species is beyond belief and the men manning these DEW Line posts were driven frantic by their bites.

The prospect of this bombing functioned as a diuretic, and the American government spoke to the Canadian government and so in 1947 the Defence Research Board, Canada Department of National Defence, requested the Entomology Division to undertake a study of biting flies and other entomological problems in the Canadian arctic and subarctic regions. The research program was in two parts (1) Investigations on life histories, habits, ecology and control of biting flies by the Veterinary and Medical Entomology Unit; (2) Studies on the system-

atics, relative abundance and ecology of biting flies *and other insects* by the Insect Systematics and Biological Control Unit.

Both phases of this project were fulfilled enthusiastically by specialists, the first phase by Dr. C. R. Twinn and his staff and the second phase by the Systematics Unit under the leadership of Dr. T. N. Freeman, with the title "Northern Insect Survey"^{51, 52, 53}. Apart from the tremendous amount of strenuous and often self-sacrificing work done in connection with life histories, ecology and the successful control of biting flies and protection from them, the words that appealed hugely to George Holland and his staff were "*and other insects*"; so, with the Defence Research Board footing the bill and making all arrangements, no less than sixty-four localities were investigated by 66 field parties since the survey began. Each party usually consisted of two men and only two localities were surveyed a second time; investigations were conducted from Nome, Alaska, right across to Greenland and north to Alert, northern Ellesmere Island, 500 miles from the geographical north pole. The investigations were many-sided, entomology being only one of them and an immense amount of valuable data was obtained from which many papers have already been published.

Approximately three-quarters of a million specimens were obtained whose distribution threw much light on Palaearctic and Nearctic Regions. The Survey also made possible the plotting of the known distribution of each species of mosquito, blackfly and tabanid of northern Canada.

Indirectly, therefore, the real or imaginary threat from the other side of the Pole has helped Canadian entomology, and the National Collection at Ottawa has benefitted as it would not possibly have done under other circumstances.

When all this material will be identified, is another matter. In 1953 an announcement from Ottawa indicated that all the parasitic insects collected in British Columbia by Dr. J. D. Tothill and Alfred Baird 40 years previously, had finally been identified and the Head of the Systematic Unit received a sarcastic letter from Dr. Tothill, now retired and living in the south of Scotland, stating that this achievement must surely rank with the 1953 coronation of the Queen and the climbing of Mount Everest! It is easy enough to collect vast numbers of insects but it is only recently that the Systematic Unit has had a representative group of men qualified to identify new and rare species.

Giving all credit where it is due — apart from sustaining the Northern Insect Survey, the Defence Research Board has been very active in what is called "Military Entomology" since about 1948, mostly the protection of armed forces from biting flies, although household and stored product insects are a concern. While reduction of insect population is aimed at, where small units must exist outside control areas, repellents must be relied on.

The Board supports many phases of this biting fly problem, chiefly by research which is conducted largely by university personnel, namely Professor F. O. Morrison of Macdonald College, Professor A. S. West of Queen's, Dr. D. H. Pengelly of Ontario Agricultural College, Professor A. J. Thorsteinson of Manitoba, Professor B. Hocking of Alberta and Professor J. G. Rempel of Saskatchewan. Moreover, the Advisory Committee on Entomological Research made up of scientists from the Universities and the Canadian Department of Agriculture, have put out the comprehensive and very fully illustrated *Armed Forces Pest Control Manual*, the *Cooperative Mosquito Base Line Survey*, which gives a valuable picture of mosquito resistance and susceptibility to insecticides in Canada, and a very complete compilation *Smell in Insects: a Bibliography with Abstracts* by Professor B. Hocking, and other pretentious publications. Altogether, the cost of D.R.B.'s entomological research has been formidable; in the past 13 years support in the form of university grants has been more than \$250,000



Fig. 7. Some senior Canadian entomologists in their student days. J. D. Tothill (1910), A. W. Baker (1911) and W. R. Thompson (1911).

and contracts with outside agencies, chiefly the Canadian Department of Agriculture, particularly in connection with the Northern Insect Survey, has been \$257,000, well over half a million dollars in all.

Acknowledging then the contribution of the Defence Research Board which has enabled the Research Branch to add to the National Collection three-quarters of a million insects of arctic and subarctic regions, this brings the total of the Canadian National Collection at Ottawa to well over three million insects, with type material of over 8,000 species and subspecies, including between 3,000 and 4,000 holotypes. In addition to the main collection, regional sections of the C.N.C. are located at most of the field laboratories of the Divisions of Entomology and Forest Biology, and these include the enormous collections of parasitic insects at the Entomology Research Institute for Biological Control at Belleville.

Other Collections in Canada

In addition to the collections belonging to the Research Branch, there exist in Canada collections at most universities and agricultural colleges, some being very substantial and featuring different orders. In the Quebec Museum and College de Levis are Provancher's types and other material.^{57, 58, 59} At Macdonald College of McGill University is the famous Lyman^{60, 61} collection of 150,000 specimens now supplemented by other systematic and economic collections, especially the Orthoptera of Canada recently featured by Professor Kevan. The collections of the Department of Biology at the University of Toronto are now in the Royal Ontario Museum⁶² which houses the Walker collection of Odonata, the largest in the country, the Walker and Urquhart collection of Orthoptera and the Wiggins collection of Trichoptera; Queen's University has substantial collections as has the Ontario Agricultural College at Guelph, especially of Coleoptera. The Department of Zoology at Western University, London, has a spectacular collection of exotic Lepidoptera and the small but specialized collections of Professor Judd. McMaster University at Hamilton has a rapidly growing collection especially of blood-sucking Diptera.^{63, 64, 65} The Department of Entomology at the University of Manitoba has well organized systematic collections of all orders for teaching purposes and very complete life history material assembled by the late Professor Mitchener and just recently, the well-known J. B. Wallis collection of Canadian Cicindelidae.⁶⁶ The University of Saskatchewan, in addition to Departmental collections especially those of mosquitoes collected by Professor Rempel, has free access to the very thorough collections of prairie insects, especially Orthoptera, Diptera and Hemiptera made by the late A. R. Brooks who was seconded to Saskatoon from the Systematic Unit at Ottawa. In Alberta, at Edmonton, are extensive collections of local insects, notably the Carr collection of Coleoptera, extensively increased by Dr. George Ball, specialist in the Carabidae. The late Professor Strickland contributed large collections of Diptera and Hemiptera of Alberta, identified to species, the basis of his annotated lists of these orders. At Calgary, Alberta, are the extensive Forest Insect Survey collections containing, notably, the bark beetle collections of George Hopping. The University of British Columbia has been a one-man job from scratch but now contains the Blackmore and three other collections of 20,000 mounted Lepidoptera, the 42,000 fully named beetle collection of the late Stace Smith from the Creston area together with 32,000, mostly named, beetles accumulated by Spencer, and the Downes⁶⁷ collection of 14,000 B.C. Hemiptera and now very greatly increased by the hemipterist, Dr. G. Scudder. The collections of Anoplura are complete for B.C. mammals, the Mallophaga and Siphonaptera are half and three-fourths complete respectively, and the total of all orders of British Columbia insects now stands at over 200,000 largely identified specimens.

Scattered across Canada are private collections of scientifically trained men who are not professional entomologists but enjoy working with insects; to mention a few of these: in Quebec we find eight Reverend Brothers collecting chiefly Lepidoptera and Coleoptera; in Vancouver, W. Lazorko, M.D. who has a magnificent collection of Ukrainian beetles and is a specialist in the Pselaphidae; and C. D. B. Garrett, a specialist in the Mycetophilidae: in Nanaimo at the Pacific Biological Station, are Ferris Neave and W. E. Ricker, specialists in Plecoptera. There are others in every province who collect for pleasure and as a hobby but their collections are not as well known as the foregoing.

There comes up now the very important question of the ultimate disposition of all amateur collections in Canada and even the general systematic collections at universities and colleges. It so often happens that children of noted collectors take no notice of their father's hobby and allow them to be destroyed by moths and dermestids. This is what happened to all the various collections of Rev. G. W. Taylor, the first Director of the Biological Station at Nanaimo and the pioneer entomologist of British Columbia and, with few exceptions, to the very representative collection of beetles by Mrs. Hippisley Clark at Terrace, B.C. The quite extensive collection of Lepidoptera, especially Microlepidoptera, of an amateur collector in Vancouver was almost completely destroyed before the remains were donated to the university in Vancouver. Right across Canada, most amateurs collect common species but very often their collections contain rarities which should be preserved in a permanent collection. And even in universities where some men make extensive and valuable local or provincial collections, there is no guarantee that their successors of the next generation will take any interest in systematics — they may be anatomists or physiologists and collections may be neglected. True, there *should* be a large collection in every province, where a continuity of care is assured but there is always the question whether rare insects should not be forwarded to the Canadian National Collection where permanent curatorship is definitely assured. This applies particularly to type specimens; should they be retained locally or sent to the C.N.C.? On the other hand, one disaster to the National Collection would perhaps remove everything; so should there not be depositories of types maintained in large collections, in central Canada as in Winnipeg, and at Vancouver?

The Canadian Entomologist

Turning from the Canadian National Collection, we come to our National Journal. Now that the *Canadian Entomologist* is truly all-Canadian, published solely by the Entomological Society of Canada since 1960, we may consider for a moment the rise in cost. The first numbers of the Journal published from 15 October 1863 onwards, together with the *American Agriculturist*, were \$1.50 per year for 12 numbers;⁸⁸ the printing was good and the number of pages increased fast. One hundred years later our Journal alone is \$15.00 for 12 issues; the cost of plates (chiefly graphs) is very high; reprints are \$42.00 for 100 copies of a ten-page article; all side issues, like the President's address at annual meetings, all records of annual meetings and discussions, all notices of exchange or For Sale, all photographs, are cut out; everything except perhaps the odd notice of publication of a new book; the printers' costs are so high that only scientific articles can be included. The Society could get the magazine printed in Great Britain for half the cost and in Czechoslovakia for one-third the cost if it were not for time lapse and the howl to high heaven of the printer's unions. To offset this high subscription rate, however, is the fact that members receive gratis, the *Proceedings of the Entomological Society of Ontario* and the very valuable series of mono-

graphs, largely taxonomic, hitherto titled *Supplements* but now called *Memoirs* of which the penultimate one by Oswald Peck, *Catalogue of the Nearctic Chalcidoidea*, is alone worth the annual subscription. Thirty of these monographs have now been put out on a wide range of topics and they constitute the last word in the way of revisions and up-to-date taxonomy of adults, and in other cases of larvae of certain families, notably the monographs by Miss M. R. MacKay.

The Editing of The Canadian Entomologist

One cannot speak too highly of the invaluable work done by Mr. R. H. Wigmore in initiating a very high standard of editing all articles for publishing in the *Canadian Entomologist* and for a time, the Entomology Division Science Service *Newsletter*. His work was rendered more difficult by the new phraseology, the new vocabulary of the New Systematics, in which words became commonplace that were never heard of before. Writing clear, good English composition is an art terribly neglected in our schools and universities and the hand of Mr. Wigmore was badly needed. His editing, and that of succeeding editors has been indeed a boon to all who publish in entomology in Canada.

Referring again for a moment to entomological education, the question arises "Why did any of you choose entomology as a life work or as a hobby?" Was it for the same reason that boys collect rocks or stamps or shells, for what may be called the 'pack rat' instinct, or were you inspired by someone else's example, or was it simply that insects attracted and fascinated you? Looking at the three great typewritten volumes on bumble bees that Theodore Frison of Illinois had written by the time he was 26 years old, I asked him, "When did you start working on bumble bees?" He replied, "When I was ten years old a teacher in school inspired me."

So many students, even in their third year at a university, are uncertain about the vocation best suited to their capabilities; to such men an interested, enthusiastic lecturer may prove an inspiration. John Henry Comstock was probably the greatest teacher of entomology in North America; because he was a pioneer he was best known but many others equally great have followed him. It is the fashion nowadays to stress research in universities, but the primary function of a university is still *teaching*. Canadian entomology has some striking examples of this: Dr. W. H. Brittain^{69,70} was a remarkably clear, concise, forceful lecturer who was also an excellent research worker; Dr. E. M. Walker of Toronto,⁷¹ himself an artist of the first water, somehow inspired classes of regular, not honours students, to produce the finest laboratory drawings of animals that any instructor could wish for; it was as if his artistic soul was imparted to the students and it flowed out through their pencil points; Professor A. W. Baker⁷² of the Ontario Agricultural College, usually called Jack Baker, instructed largely through his hands; the movements of his fingers somehow illustrated the points he wished to put across, not his drawings on the board because he used chalk only to write names or anatomical details of insects. Amongst the great entomological teachers in Eastern and Central Canada we note Dr. Georges Maheux⁷³ of Laval University, the late Professor W. Lochhead⁷⁴ of Macdonald College, Dr. J. D. Detwiler⁷⁵ of Western University and Dr. R. A. Wardle⁷⁶ and the late Professor A. V. Mitchener⁷⁷ of the University of Manitoba. In Western Canada at the University of Saskatchewan is Professor J. G. Rempel, program Chairman of this Centenary Conference; speaking at the inaugural meeting of this Society at Victoria, B.C., Dr. Rempel delivered one of the most lucid, rapid-fire, factful and beautifully illustrated addresses I have ever heard; also at Saskatchewan was another brilliant

lecturer and versatile biologist, Dr. L. G. Saunders:⁷⁸ these two men had to do with the training of many of the leading entomologists in Canada today, namely A. P. Arnason, C. W. Farstad, R. Glen, R. H. Handford, K. M. King, H. Macdonald, G. F. Manson, H. L. Seamans, J. R. Vockeroth and Margaret MacKay. At the University of Saskatchewan also, the late Dr. A. E. Cameron was a brilliant lecturer, research worker and scientific illustrator. The University of Alberta had Professor E. H. Strickland^{79,80,81} whose every lecture was an oration that showed the most careful and precise preparation.

These are just a few examples of outstanding *teachers* who have impressed, inspired and stimulated students and who have undoubtedly influenced men to become entomologists. If you look at the list of entomologists occupying top positions in the Federal service, you will be struck by the number who have come from Alberta and Saskatchewan; without a shadow of a doubt these men are the product of the Professors of Entomology under whom they worked.

Occasionally, students are influenced by other factors. When R. C. Treherne⁸² was stationed in British Columbia as the first Federal entomologist to hold office in the province, he was seconded to the University for three months each spring to instruct students of agriculture in economic entomology. He was an exceedingly methodical and precise worker and his lecture outlines were models of their kind. One of the librarians informed me that she had studied under him. I remarked, "Oh, are you interested in entomology?"

"Oh no, but he had such a beautiful voice."

As instructors have come and gone so have the concepts of entomological education changed in the last two generations. At the turn of the century and in some institutions even now, the main thing was identification of insects to order, family and in the case of the commonest species, to individual names; for such recognition, a collection of insects was a necessity for every student; then followed a little external and internal anatomy and, with common species, the outlines of life histories. There was no histology or embryology, no detailed structure or function, no physiology, no ecology, no distribution in time and space.

Chronologically, entomology was taught in Canada as regular courses, first at the Ontario Agricultural College in 1877 then at Truro, Nova Scotia in 1888; apiculture was taught at Guelph in 1895, general entomology at Manitoba Agricultural College in 1906, at Macdonald College in 1907 by Lochhead and Swaine and at Toronto University Professor E. M. Walker gave a course in Forest Entomology in 1908, the same year that Professor Lochhead gave instruction in entomology at the Quebec Society for the Protection of Plants.⁸³

In agricultural colleges, entomology was taught in increasing degree of detail, from the first to the fourth year, the last year being practically entirely systematic and economic. In institutions where there are Departments of Entomology in Agricultural faculties, this plan is still largely followed with new phases and modern concepts being added.

In universities on the other hand, where the departments of zoology aim to give a broad-based pyramid of instruction in all phases of zoology, even as Hewitt favoured, there is usually only one entomologist who gives one or perhaps only two courses and then only in final years.

According to their latest 1962-1963 calendars, only the twelve leading universities in Canada give instruction in entomology. The Ontario Agricultural College gives ten courses and four in the graduate school; Alberta gives eight; Manitoba, two in zoology of which one is medical and veterinary entomology and seven in general entomology; Macdonald College, five, one of which is

medical entomology; Carleton University, three; Western and Saskatchewan, two each, one of Saskatchewan's being medical entomology; British Columbia, six with two in forest entomology. The University of Toronto apparently gives only one course.

This whole situation of training in entomology in Canada^{81,85,86} is very different from that in most large universities in the United States where Departments of Entomology either in Liberal Arts or in the Faculty of Agriculture have large numbers of men on their staffs, experts in different phases of the subject.

It stands to reason therefore, that while a student will probably get a first class grounding in zoology and entomology in a Canadian institution up to a bachelor's degree, it would be better for him to go to an American university for advanced degrees in economic entomology, where he will come into contact with several specialists thereby broadening his whole horizon, rather than working in Canada under one man, unless that man is a specialist in the line the student wants to follow, such as morphology or taxonomy. It is of interest, however, to note that there is an increasing tendency for Canadian students to go to universities in Europe, especially to Great Britain, to work under men of particular renown. These students are mostly men in the Research Branch of the Federal Service where their graduate work is facilitated or made possible by the system of financial grants in the form of part-pay, another far-sighted institution of the great Dr. Neatby.

Conspicuous in its assistance to advanced research in entomology, is the National Research Council of Canada, which allotted no less than \$89,500 in 1961 and 1962 to faculty members in twelve universities across the continent from Dalhousie to Vancouver, for varying research projects. These were very substantial grants varying from \$8,000 downwards; at Toronto University, four men got \$22,150, Macdonald College \$13,600, British Columbia \$11,500, McMaster \$8,000 and Western and Manitoba, \$7,500 each; at Saskatchewan in 1962 it was \$12,100; the other institutions got less.

However, since the end of World War II there has been a great advance in graduate training in entomology.^{87,88,89} At first only Toronto and McGill (Macdonald College) gave doctor's degrees in entomology: since then seven additional universities are granting Ph.D.'s — Queen's University, University of Western Ontario, and the Universities of Manitoba, Saskatchewan, Alberta and British Columbia. The Universities of Laval and Montreal are recorded as granting Ph.D.'s in entomology but their latest calendars are not clear on that point.

Nevertheless, since the older, larger universities in the States have such large staffs of from 15 to 20 specialists in separate departments of entomology, many Canadian students still go south of the Line for post-graduate work, especially in economic entomology.

Along with other phases of the changing face of entomology, is one of increasing interest and rapid growth which I will put into the words of Professor John Stanley in his address at the annual banquet of the 75th Anniversary of the Montreal Branch of the Entomological Society of Ontario on 4 November 1948, held at McGill University, and I quote: "... plants and animals live in groups and associations and populations. The investigations of the actions and reactions of groups of animals require a mathematical approach and three difficulties at once arise. First, many biologists of the "old school" decry the use of mathematics. They feel that it is inapplicable to the problems in hand. . . . It is quite true that the applications are difficult, often *extremely* difficult, but they are also *often* valid and if so *nearly always* useful. [The italics are mine.] Secondly, for some reason, the biological mind is seldom attracted to mathematics or comfortable in

a mathematical atmosphere. This may be innate, similar to the well-known lack of mechanical ability in poets . . . or perhaps due to the strong counter-attractions, financial and otherwise, of chemistry, physics and engineering; potentially brilliant minds simply do not take an interest in biology." [And Stanley would change this situation by raising financial standard of biologists and . . . by convincing the public and financial bodies that biological research needs large expenditures and large staffs.] "Thirdly, the mathematical approach to biological problems is undoubtedly one of *extreme* intellectual difficulty . . . it is not at all easy to gain enough training in the dual art of mathematics and biology. We shall have to get help here from professional mathematicians as well as training our own men. We shall have to try and arrange for a flow of students from the *cream of the crop of mathematicians* [italics mine] and to supplement their activities with modern aids to calculation. A full-scale electronic computer in Canada backed up by an adequate staff of bio-mathematicians and reserved exclusively for biological problems would yield results of the greatest value. I am afraid though that the possibility of its being set up in the next four years is vanishingly small." That was written fifteen years ago.

Now I imagine that very few of you here know that Professor Stanley did some tremendous mathematical work for Britain against the flying bomb in London; years ago he did a magnificent piece of work on the anatomy of a mite and you know how small mites are; he has done many papers on the mathematics of the potential of two flour beetles in one cubic centimetre of flour and at present he is devoting all his time to the planning of the new eight-million dollar biology building at McGill. However, he said in the address already referred to that "he was not really an entomologist" and there are some who would agree with him. Now he read Darwin's *Origin of Species* three times during his undergraduate days, and it is many years since I laboriously read it once, but I cannot remember seeing $2 + 2 = 4$ anywhere in the book; but of course, Darwin is terribly out of date.

It is significant, though, that the Department of Zoology at the University of British Columbia has for some years required all its students who major in zoology to be familiar with the Calculus, and in this year's calendar of the Ontario Agricultural College at Guelph, the Calculus is required of all those who hope to graduate in entomology. It is a sign of the times.

In Vancouver, two men worked on the behaviour and natural control of the European earwig for one year, trapped assiduously until they had collected over 120,000 specimens and then they wrote up their results. It was a very fine piece of work with three pages of formidable mathematical formulae in the middle. When I saw one of them I congratulated him on the paper saying, "But I did not know that you were a mathematician." Said he, "I am not; ask the other author;" and in due time I got the same reply from the joint author. "Then who did all the mathematics?" "Oh, Professor X.Y.Z. of the department of mathematics at the University." "But why?" And I got one word in reply, "Eyewash."

On the other hand, mathematics is coming into its own in the complex problems of fisheries and the control of insects that cause such immense damage in forests, like the spruce budworm in New Brunswick and the hemlock looper in British Columbia. When the Director of the Pacific Biological Station at Nanaimo was recently made Deputy Minister of Fisheries, a young Professor of Fisheries at the University, Peter Larkin, was appointed in his place, largely because he made a name for himself when he graduated from Oxford University. The Biological Station deals largely with the 70-million-dollar-a-year salmon industry based upon six species of which sockeye is the most valuable. The

joint Fraser River Salmon Commission is composed of a large staff of American and Canadian scientists who spend their entire time working on these fish biologically and mathematically in the greatest detail. This July, 1963, a bumper crop of sockeye went up the Fraser River; in the Strait of Juan de Fuca, American purse seiners averaged \$1,365 per day per boat for sockeye alone, besides about \$100 more for pinks; (however, the Communist-led Canadian fisheries union was out on strike as usual for three weeks, thus missing the peak of the run). Concerning this year's run, Lloyd Royal, director of the Fisheries Commission, said that there is no precedent for such an early abundance of sockeye and pinks, six days ahead of time, upsetting all calculations based on 31 years' statistics.

At Little River out of Shuswap Lake there is a 60-yard wide 3-mile straight strip of water where thousands of people line the banks to watch the hordes of 5 lb. to 7 lb. fish passing up on their way to spawning grounds. This year two Salmon Commission scientists were on the bank discussing this record-shattering run and one remarked, "It is unprecedented and truly embarrassing; it has upset all our calculations of Dynamic Programming and the mathematical theory of multi-stage decision processes; the fish have simply ignored the fundamental notions, the Markov property and Bellman's principle of optimality, which makes use of recursive relationships; they have ignored all algebraic designations compatible with Fortran computer program language specifications, all our sets of parameters and all our calculations on the I.B.M. 1620 machine."

And to the amazement of both scientists, one of the sockeye fish suddenly lifted itself half out of the water and in a remarkably clear voice said, "So Watt?"¹⁰⁰

Leaving the mathematical side of entomological problems and this rather fishy matter of biometry, we come to the chemistry of our science. The first years of the 1940's were of great importance to the world and to Canada; two bombs were exploded over Japan in early August 1945, and the shock spread round the world; but in 1942, three years previously, occurred an explosion that, from one standpoint at least, ranked with the two atomic ones, and that was the release to the world of dichlorodiphenyl trichlorethane or DDT, a poison of importance equal to that of the atomic bomb because it started an era of insecticides whose potency exceeded anything ever before conceived, surpassing the wildest imagination. If fission of uranium isotopes in an atom bomb produces a chain reaction, so does the promiscuous spraying of DDT produce utterly unforeseen chain reactions. Several noted cases of this kind are in literature:—DDT is sprayed on to a lawn, earthworms ingest the poison on particles of soil, robins eat the earthworms and die; a poison is sprayed on a stream, insects ingest the poison and are eaten by fish, the fish then die; a peregrine falcon lays an infertile egg: traces of four chlorinated hydrocarbons are found in the egg, imparted to it by the bodies of birds that the falcon had eaten.

Both these inventions, the atom and the hydrogen bomb, and residual chlorinated hydrocarbon and synthetic phosphorus insecticides, have almost unbelievable potentialities for destruction; the first type leaves a strontium 90 residue after the first explosion and we have yet to determine the long term effects of it; the initial destruction is either marvellous or calamitous, depending upon whether it occurs on enemy territory or on ours: this parallels the effects of so many recent insecticides, the initial application is devastating to insects and we have not yet determined the long-term residual effects. Both forms are non-selective; they kill the bad and the good: as far as atomic explosions are concerned, we are still finding out the effects on human beings, and we have no idea if insects are suffering too: and we do not know the long-term effects on human beings, of the insecticides we use.

While this is not strictly Canadian entomology, it is a problem that we share with the people of the United States where greater numbers and greater quantities of insecticides are used than anywhere else on earth and if there are going to be any long-term evil effects from the misuse of these poisons, they will occur in Canada as well as in the States. The number of these chemicals is growing all the time as may be noted in the Kenaga list,⁹¹ June 1963, of the Dow Chemical Company, Midland, Michigan, where 236 insecticides and their allies are listed under 15 headings; the list includes only those that have been field-tested and for which results have been published, without their long lists of analogues or homologues, still less the truly terrifying lists of formulations, running into over 8,000, as are given in the *Pesticide Handbook, 1963*.

To mention one instance only of the intensity of research and the employment of chemicals against insects, Fernando Lopez D. of the U.S.D.A. Research Service, working in Mexico on lure studies with the Mexican Fruit Fly, *Anastrepha ludens* (Loew), tested no less than 8,000 chemical compounds and miscellaneous mixtures. If he had reported using 80 compounds one would be surprised, but 8,000 is almost unbelievable — to attract one miserable species of pestilential fly to its doom!⁹²

Thank heaven many insects are developing immunity to these insecticides!

Apart from the volumes and volumes and hotly contentious articles that have been written for and against modern insecticides⁹³⁻¹⁰⁰ and of which discussion here is out of place, there are two effects which in my humble and limited experience may be traced to the vigorous salesmanship of commercial companies who manufacture and retail insecticides, especially aerosol bombs, which are procurable from every drugstore, hardware and flower store in the country . . . the first effect being, that the man in the street and especially his wife at home, is infinitely more conscious of insects now than they were twenty years ago; one strange insect in the house is enough to send a housewife screaming for help, and sympathetic and helpful pest-control operators put down another payment on a Cadillac or a Chrysler or a larger power boat. The second effect of this constant bleat about warfare against hostile insects, is to induce fear or hatred of insects, insectophobia or psychic disturbances produced by insects. I have now some 33 case-histories of this trouble, being readied for publication. This phobia may be partly attributable to the tensions and stress of modern life venting itself in the form of exaggerated fear of insects; but it is very real.

Now, returning to a consideration of entomologists. If we sometimes wonder why young men take up this calling, we may equally well consider older entomologists as they appear now and wonder what they were like and what their aptitudes were when they were young. For instance, looking at Dick Painter, highly honoured in Alberta and Saskatchewan for his extension services in the War against cattle warbles, who would think that as a young man he could do the 100-yard dash in ten seconds which is the modern equivalent of a four-minute mile or a 16-foot pole vault?; think of Charlie Petch, famous for his work on fruit tree and general farm insects in Quebec for 35 years and visualize him as a lean, long-distance runner coming sixth in the Boston Marathon when he was only 17 years old, and as a student at college, beating Shrubbs, the world's champion long-distance runner, over the ten-mile route; consider the gentle Hod Seamans, famous and medalled for his researches on prairie cutworms and can you picture him as an expert with a Colt automatic in his youth; or the researcher, teacher and administrator Kenneth King, with the making of an Episcopalian minister in him, or that altruistic, indomitable Scotsman Jimmie Marshall as a one-time champion basketballer? Was there anything in Edmund Walker in his younger days to

indicate his pre-eminence in the study of dragonflies or in Eugene Munroe, his mastery of swallowtail butterflies? Did George Holland ever indicate a flea or Brian Beirne a leafhopper — except for their bounding enthusiasm? Who would realize that Jack Baker had entirely missed his vocation when he followed entomology instead of politics, when he could have been Premier of Ontario 30 years ago or even Prime Minister of Canada by now?

Who can possibly foretell what young men will turn into or what stolid, solid entomologists were like in their youth? Look at the photographs of these young men to identify them and bear in mind what they have achieved by now.

Looking at these youngsters in front of me now, brilliant minds, pulsing with enthusiasm, practically all with doctor's degrees — it staggers the imagination to think what they will achieve in the next half century, to what heights they will carry the banner of Canadian entomology.

Mr. Chairman, may I congratulate the Committee for their selection of this young, beautiful Carleton University for these Centennial meetings in the centre of the entomological headquarters of Canada, and for their choice of men to be honoured by this University this afternoon with Honorary Doctors of Science degrees. How wisely have they chosen E. M. Walker, W. R. Thompson and E. M. DuPorte, to represent the latter part of the first century of Canadian entomology, older men full of wisdom and honour, who have made great contributions to science and to Canada; and to one young man, G. P. Holland, to lead entomologists into the beginning of the second century.

It augurs very well.

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MR. G. P. HOLLAND:

Professor Spencer, before calling upon Dr. H. R. MacCarthy to render the official thanks of the assembled delegates and guests, I must make a comment of my own. As one of your old students, Sir, I cannot describe my feelings as, nostalgically, I listened to the old familiar voice holding forth in the old familiar style!

Now, ladies and gentlemen, I am pleased to introduce Dr. MacCarthy of the Department of Agriculture Research Station at Vancouver.

DR. H. R. MACCARTHY:

As one of Professor Spencer's fortunate academic offspring I claim the honour and pleasure of thanking him for this historical review. In the past summer I have seen less of Professor Spencer than for many years — for good reason: he has been immersed in preparation for the address we have just heard. I have been impressed with the painstaking search of literature, the checking and double-checking and agonized rejection that have gone into this deceptively breezy account. As I listened it struck me that perhaps Professor Spencer was revealing a little of his extraordinary ability to stimulate students and to transmit by a sort of osmotic process, some of his own enthusiasm. Perhaps the stimulus comes from the combination of careful preparation superimposed on his own natural zest. Or the natural zest superimposed on the careful preparation. I have never been sure. Professor Spencer's day-to-day lectures were always enjoyable, but one realized only later by hindsight how much solid organization went into them. One woke up to the fact long afterward that no matter how seemingly irrelevant or apocryphal, his anecdotes nailed down in the mind and memory some point that could not, willy-nilly, be forgotten. The solid grounding given by Professor Spencer to his students is attested by the numbers of them who have gone on to attain high reputations and positions.

There is, of course, much more to Professor Spencer as a person than an inspiring teacher and a sought-after speaker, but since I have no wish to embarrass him I shall not expound on this. But it is with full confidence that I speak for everybody gathered here, when I say: thank you, Sir, very much indeed, for your comprehensive, carefully selected, thoroughgoing, thoroughly enjoyable review of a Century of Entomology in Canada.