sip newsletter

society for invertebrate pathology

Volume 16, Number 3
September 1984

18th ANNUAL SIP MEETING
SAULT STE. MARIE, ONTARIO, CANADA
AUGUST 4-8, 1985

The 18th Annual Meeting of the Society for Invertebrate Pathology will be held at Sault Ste. Marie, Ontario, Canada on August 4-8, 1985. Staff of the Forest Pest Management Institute (FPMI), Canadian Forestry Service, Sault Ste. Marie, Ontario, Canada are hosting the 1985 meeting with Dr. Terry Ennis as Chairman of the Local Arrangements Committee. There are 10 SIP members in Sault Ste. Marie, so Terry will have plenty of help.

Sault Ste. Marie, Ontario, (population 84,000) is located at the junction of Lake Superior and Lake Huron. A bridge crosses the channel to the twin city of Sault Ste. Marie, Michigan. There are several flights per day to and from Toronto and Winnipeg. Sault Ste. Marie, Michigan, has daily air service to and from Chicago and Detroit.

Those of you who have been Society members for more than 7 years, will associate Sault Ste. Marie with the Insect Pathology Research Institute (IPRI) which was founded in 1948. Such names as Cameron, Bird, Angus, MacLeod, Bergold and Krywienczyk are linked to pioneering research in insect pathology. The Forest Pest Management Institute was established in 1977 when the Chemical Control Research Institute (CCRI) in Ottawa and IPRI were amalgamated and staff of CCRI moved to Sault Ste. Marie.

The Forest Pest Management Institute is part of the Canadian Forestry Service which in turn is part of Agriculture Canada. The Canadian Forestry Service is a relatively small government agency with headquarters in Ottawa, six regional research establishments across Canada and two national research institutes. The Ontario regional research laboratory called the Great Lakes Forest Research Centre (GLFRC) is also located in Sault Ste. Marie and shares premises, administrative and typing services with FPMI. It should probably be worded that we share facilities with them as GLFRC has a staff of about 200 people and FPMI has a staff of 87! The research complex is on the waterfront and is located about 2 to 3 miles from the Holiday Inn where the meeting will be held.

In a previous Newsletter (April, 1981) the amalgamation of IPRI and CCRI under the direction of Dr. George Green was explained and the FPMI program was outlined. It was a natural marriage of two institutes which shared the same objectives. CCRI staff brought with them a wealth of knowledge and expertise in such areas as formulation of control agents for aerial application, application technology, aircraft calibration, spray cloud behavior, field trial assessment, deposit analysis and environmental impact monitoring, all of which can be applied to biorationals as well as chemical control agents. Many senior staff members have retired in recent years and the new recruits have added greatly to the expertise brought by members of the original IPRI and CCRI.

A new complex for GLFRC was completed in 1976, and staff of the newly formed FPMI were housed in vacant space there and in the original IPRI building. The complex is currently overcrowded but an extension now being built will relieve this, and provide, for the first time, the opportunity to house all FPMI staff in one physical location. Other improvements are being made on the site and the total cost is estimated at $17 million.

The Canadian Forestry Service complex in Sault Ste. Marie which currently houses the Great Lakes Forest Research Centre and the Forest Pest Management Institute.

Visitors who have sentimental memories of the old IPRI building will have a last chance to see it in August, 1985, as it is scheduled for demolition the following month. When we offered to host the meeting, we had no idea that construction would be in full swing. However, we are sure that tours and visits to individual laboratories will be arranged, although we do not expect to have moved into our new quarters.

The SIP members who are looking forward to seeing you in Sault Ste. Marie are Terry Ennis (Program Director, biorational control agents), Sardar Sohi, John Cunningham, Basil Arif, Bill Kaupp, Gary Wilson, Paul Fast, Dave Tyrrell, Dave Perry and Jean Percy. We are also sure that retired staff members-Tom Angus, Don MacLeod and Janina Krywienczyk-will be happy to meet old friends and colleagues and join in the social events.

Pile-driving for a new extension to the complex which will house Forest Pest Management Institute staff: the old Insect Pathology Research Institute in the background will be demolished when this new building is completed.

We do not have much to offer for our friends who are marine pathologists, but there is a Fisheries and Oceans Sea Lamprey Control Centre in town and we shall try to arrange a tour of that facility. We are putting a lot of effort into developing an exciting social program and expect to make the 1985 meeting a memorable event.

SIP NEWSLETTER

The SIP Newsletter is produced four times a year by the Society for Invertebrate Pathology. Annual dues (U.S. funds) in the Society are: regular members, $11.00; and students, $4.00. Members receive the SIP Newsletter free. Application forms for Membership in the Society may be obtained from the Treasurer, Dr. Aaron Rosenfield, Oxford Lab., NOAA, Nat'l. Marine Fisheries Service, Oxford, Maryland 21654, U.S.A.

Council Officers of the Society are:

President	Wayne M. Brooks, USA
Vice President	H. Denis Burges, England
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Send news items and other contributions to:

Sardar S. Sohi, Editor
SIP Newsletter
Forest Pest Management Inst.
Canadian Forestry Service
P.O. Box 490
Sault Ste. Marie, Ontario Canada P6A 5M7

Instructions for Preparing Camera Ready Copy:

The SIP Newsletter is produced by offset printing. For general format follow a recent copy of the Newsletter. Type single spaced. Width of typed material should be no more than five inches, but use most of this width to conserve space. Thank you.

Accommodation

We have broken with the tradition of holding the meeting on a university campus and offering accommodation in halls of residence. The 1985 meeting will be held in the Holiday Inn, a luxury hotel on Sault Ste. Marie's waterfront and we have a tentative reservation for 90 rooms. The price is $55 Canadian per night + 5% sales tax, regardless of the number of occupants (within moderation, of course). This will be ideal for families; delegates may wish to have a single room or share a room at $27.50 each per night, and students may consider adding a roll-away and sleeping 3 to a room. The Canadian dollar is currently worth 70¢ US, so the $55 Canadian converts to about $40 US making this price even more attractive to our colleagues south of the border.

The Holiday Inn in downtown Sault Ste. Marie on the St. Mary's River where the 1985 SIP meeting will be held.

This Holiday Inn was built 10 years ago; all rooms are air-conditioned and have a view over the water. There is an indoor swimming pool, sauna and whirlpool. A large mall with over 80 stores and a cinema is adjacent to the hotel. We plan to hold all the scientific sessions and most of the social events at the hotel and would like to see all delegates booked into it. There are many other hotels in Sault Ste. Marie, some of which may offer slightly lower rates, but none are so well located and attractive as the Holiday Inn. Early August is prime tourist season and there is a high room occupancy rate in Sault Ste. Marie during this period. The Holiday Inn will not hold rooms for us in the off-chance that unregistered delegates turn up at the last moment, so we shall be making a very strong plea for pre-registration when we mail out forms in a later issue of the Newsletter.

Another view of the same Holiday Inn on the St. Mary's River waterfront.

Sault Ste. Marie is on the Trans Canada Highway and is also a major entry point to Canada from the USA. We shall be dealing with the principal tourist attractions in the next issue. These include boat tours of the Canadian and American locks,a 1-day train trip to the Agawa Canyon and the scenic drive north with panormaic views over Lake Superior. You may well wish to extend your visit to Sault Ste. Marie beyond the dates of the meeting.

Contact John Cunningham for accommodation and other local arrangements, and Sardar Sohi for the Scientific Program at the address given below.

Local Arrangements Committee
SIP 1985 Meeting
Forest Pest Management Institute
Canadian Forestry Service
P.O. Box 490
Sault Ste. Marie, Ontario
Canada P6A 5M7

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SIP ELECTION RESULTS*

President	- H. Denis Burges
Vice President	- John C. Harshbarger
Secretary	- Elizabeth W. Davidson
Treasurer	- James R. Fuxa
Trustee	- Brian A. Federici
Trustee	- John A. Couch

*As a result of the late withdrawal of R.H. Goodwin as a candidate for Treasurer, James R. Fuxa was declared as the automatic winner of this office.

John D. Briggs was elected to Honorary Membership.

Jean R. Adams, Secretary

JOHN BRIGGS ELECTED HONORARY MEMBER

In recognition of his contributions to SIP and the discipline of invertebrate pathology, Dr. John D. Briggs has been elected an Honorary Member. Dr. Briggs has quietly and sustainedly contributed to the objectives of the Society for Invertebrate Pathology for many years. He began by organizing the first annual meeting at Ohio State University in 1968, went on to become Vice President in 1970 and President in 1972. He then accepted the duties of being SIP Representative to the International Union of Biological Sciences (1974), the World Federation of Parasitology (1974), and the Pacific Science Association (1981), and has faithfully discharged these duties until the present. Dr. Briggs suggests and brings about cooperation among others, in the doing of research on invertebrate pathology, mainly on an international level. He has been active and influential in groups dealing with decisions on safety and efficacy of microbial insecticides. He is dedicated to the idea of encouraging development of young scientists. By his initiative and prolonged personal labor, he has furthered the communication and cooperation of invertebrate pathologists in general and those in our Society in particular, by producing the Directory of Invertebrate Pathologists; by working diligently and at great length, and often at considerable personal inconvenience, to find sources of funds to support attendance at the International Colloquia of Invertebrate Pathology; and by his long-time personal involvement in developing the discipline and practical aspects of invertebrate pathology in emerging countries. As well, Dr. Briggs has always proven willing and able to serve the ends of our Society by chairing or serving on working committees that involve effort, time and a great deal of thought. His interest and devotion to the furtherance of the aims of invertebrate pathology and our Society have been, and no doubt will continue to be, unflagging.

Phyllis T. Johnson
Past President

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SYMPOSIUM

Make plans to attend the Annual Meeting of the Entomological Society of America in San Antonio, Texas, Dec. 9-13, 1984. The new Insect Pathology and Microbial Control subsection will have a symposium convened by Max Summers and Lou Falcon and entitled "Progress and Development in Insect Pathology Important to Biotechnology and Integrated Pest Management." Speakers and tentative titles will include:

Dr. John Briggs, "Microbial Agents with the Best Potential for Development through Biotechnology: Past and Present."

Dr. James Maruniak, "In the Future, What Can We Expect from Genetically Engineered Microbial Agents?"

Dr. Clinton Kawanishi, "What Are the Predicted Ecological Hazards Associated with Genetically Engineered Microbial Agents on the Environment?"

Dr. Loy Volkman, "What Are the Tools for Evaluating Ecological Hazards?"

Dr. James Fuxa, "What Would Be a More Ideal Approach for the Successful Development and Utilization of Microbial Agents in IPM?"

POSITIONS AVAILABLE

INSECT VIROLOGIST/MICROBIOLOGIST. Postdoctoral research position available 1 September 1984 to study the quantitative aspects of baculovirus infectivity and pathogenicity in insect hosts. Candidates must have a strong interest in viral population dynamics and experience with in vivo assay is preferred but not essential. Appointment for 3-year period. Please submit curriculum vitae and names, addresses, and telephone numbers of three references to: Dr. P. R. Hughes, Insect Pathology Resource Center, Boyce Thompson Institute for Plant Research at Cornell University, Ithaca, New York 14853. An Affirmative Action/Equal Opportunity Employer.

MOLECULAR BIOLOGIST with the Biological Control of Insects Laboratory of the Agricultural Research Service, U.S. Department of Agriculture, Columbia, MO. Career Federal Service. The incumbent will be assigned to a long-term program of fundamental research on the use of beneficial microorganisms to control insect pests. Candidate will develop independent research program on the molecular biology and genetics of pathogenic microorganisms (e.g., Insect Viruses: Baculoviruses) of insect pests. A knowledge of molecular biology/genetics is required. Postdoctoral experience desirable. Salary: GS/M-11/12/13 ($25,489 - $47,226) based on qualifications and experience. The closing date for receipt of required Federal application forms is September 14, 1984. For applications contact: Jerrie Brooks, USDA-ARS-B93; Personnel Operations Branch; Building 003, Room 318H, BARC-West, Beltsville, Maryland 20705. Telephone (301) 344-4567. Candidates must be U.S. citizens. An Equal Opportunity Employer.

APPLIED POPULATION ECOLOGIST. Will become key member of a research team investigating the distribution of pathogens in insect populations. Responsibilities include conducting field research in descriptive epizootiology and translating observed associations into systems models. Validation of models using experimental

epizootiological techniques will be conducted using both growth chamber and field studies. Strong background in entomology, population ecology and systems modeling required. This is a full-time USDA-ARS position (GS 12/13), depending upon qualifications.

POSTDOCTORAL POSITION. Insect Pathologist required to investigate Entomophthoralean infections in plant- and leafhoppers on rice. Investigation of relative pathogenicity and environmental fitness of numerous isolates will be followed by epizootiological investigations in Southeast Asia. Willingness to live and work in a developing country is important. Must have training in mycology, insect population dynamics as well as insect pathology. Position available early Fall 1984 for three years. Competitive salary, additional living expenses during overseas assignment.

POSTDOCTORAL POSITION IN INSECT MYCOLOGY. Available Fall 1984 to study comparative nuclear cytology and development of Entomophthorales for up to three years. Strong background in cytology, development, light and transmission electron microscopy essential. Competitive salary.

Send curriculum vitae, publication record, brief statement of research interests and goals, names of three references for the above three positions to: Dr. Richard S. Soper, Research Leader, USDA-ARS Insect Pathology Research Unit, Boyce Thompson Institute, Ithaca, N.Y. 14853.

RESEARCH ASSOCIATE POSITION. Insect Pathologist needed to conduct research on diseases (primarily fungal) of cowpea and bean pests and to direct research of graduate insect pathology students. To be located in Goiania, Goias, Brazil 3-4 years. Ph.D. plus experience preferred. Salary US $24,000-$34,000 (depending on qualifications) plus housing allowance. Please send resume and names of three references to: Donald W. Roberts, Insect Pathology Resource Center, Boyce Thompson Institute, Tower Road, Cornell University, Ithaca, N.Y. 14853 U.S.A.

ZOOLOGIST/MALACOLOGIST. Xytronyx, Inc., a new biotechnology company, has an immediate opening for a malacologist.Very competitive salary and benefit package. Candidates should have Ph.D.; some experience in protein chemistry helpful. Please send resumes and names of three references to Director of Personnel, Xytronyx, Inc., 645 North Michigan Avenue, Suite 645, Chicago, Illinois 60611.

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COLOR SLIDE ATLAS OF INVERTEBRATE PATHOLOGY

The Society for Invertebrate Pathology announces availability of a teaching slide set consisting of 200 2x2 color transparencies of invertebrate pathogens and diseases. The Atlas is arranged into five subject categories: Bacteria, Viruses, Fungi, Protozoa, and Nematodes. Some of the topics illustrated include pathogen life stages, gross pathology, histopathology, cultures, host response, and symptomatology. The slides are numbered, collated, and come with a complete syllabus. Each set is $40 (U.S.) and is shipped postage paid. Overseas orders should add $5 for airmail delivery. Make check or money orders payable to the Society for Invertebrate Pathology. Payment must accompany order. Orders should be submitted to: Randy Gaugler, Department of Entomology, P.O. Box 231, Rutgers University, New Brunswick, NJ 08903.

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COMPREHENSIVE INSECT PHYSIOLOGY, BIOCHEMISTRY & PHARMACOLOGY

Edited by L.I. Gilbert, The University of North Carolina, USA, G.A. Kerkut, Southampton, UK.

This 13-volume series covers all the major topics of Insect Science. The first eight volumes include accounts of all the major physiological systems in Insects. Volume nine deals with the physiology of Insect Behaviour, volume ten with Insect Biochemistry, volume eleven with Insect Pharmacology and volume twelve with Insecticides. The volumes provide the reader with the classical background to the literature and include all the important basic material. In addition special emphasis is given to the literature from 1950 to the present day. A balanced account is presented so that the reader is made aware of the various research groups working on a common subject even if the account is based mainly on the work of one group.

Contents:

Volume 1 Embryogenesis & Reproduction
Volume 2 Postembryonic Development
Volume 3 Integument, Respiration and Circulation
Volume 4 Regulation: Digestion, Nutrition, Excretion
Volume 5 Nervous System: Structure and Motor Function
Volume 6 Nervous System: Sensory
Volume 7 Endocrinology I
Volume 8 Endocrinology II
Volume 9 Behaviour
Volume 10 Biochemistry
Volume 11 Pharmacology
Volume 12 Insect Control
Volume 13 Cumulative Subject Author and Species Indexes

Special price for orders received before 31st October 1984 US $1950.00. Regular price US $2750.00

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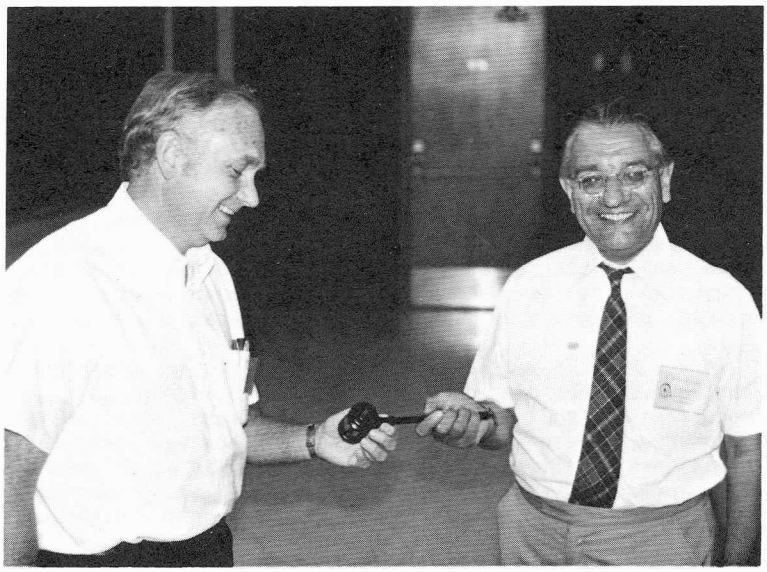
17th ANNUAL MEETING OF THE SOCIETY FOR INVERTEBRATE PATHOLOGY
University of California, Davis
August 5-9, 1984

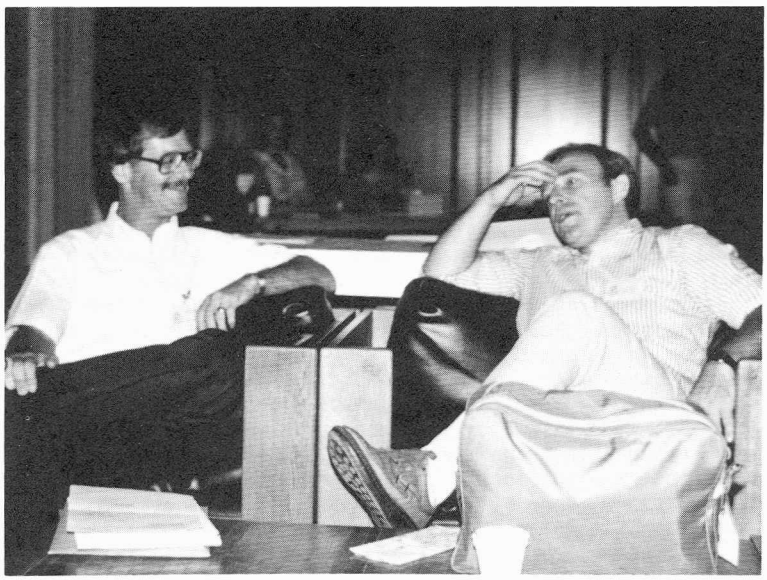
The 17th Annual Meeting of the Society for Invertebrate Pathology had a total of 170 registered participants. Attending were scientists from several foreign countries including Argentina, Australia, Brazil, Canada, France, Israel, Italy, Japan, Mexico, United Kingdom, and West Germany. The symposium, contributed papers, poster sessions and workshops were well attended. The scientific exchange during these sessions and on a one-to-one basis was excellent.

Mabry Steinhaus, wife of the honoree Edward Steinhaus, and Y. Tanada, Founder's Lecture, with their certificates of achievements.



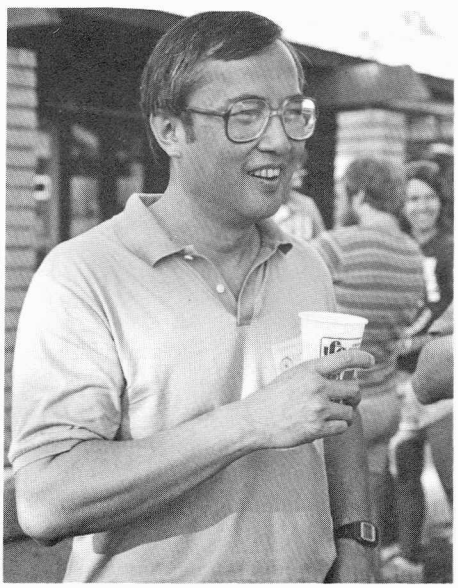
Wayne Brooks turning gavel to Denis Burges, President from 1984 to 1986.

Joel Margalit and Israel Ben-Ze'ev discussing science.

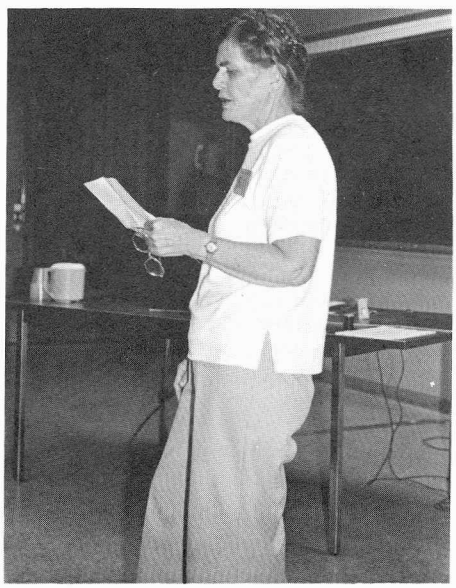


Jim Fuxa and Chris Payne discussing (?) science.

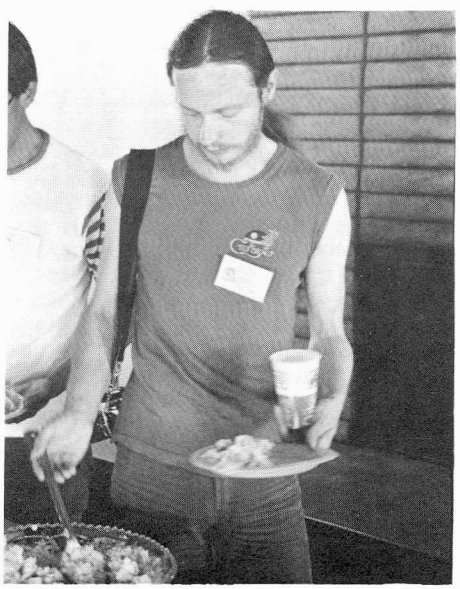
R to L. Mark Goettel, David Cooper, Y. Tanada getting food.



Clinton Kawanishi enjoying a refreshment at the barbecue.



Phyllis Johnson presenting her report at business meeting.



Jean Charles in self-service line at barbecue.

To further stimulate scientific exchange and to allow for discussion of "old times", a number of social events were planned. On Sunday, the opening social had over 100 attending. Abundant food and free wine were served. No one left hungry that night unless they were on a diet or too busy talking to eat. After the Safety Workshop on Monday night, (compliments of BioChem Products), soft drinks and food were served to over 90 participants. After a full day of contributed papers and symposia on Tuesday, more than 130 participants and guests enjoyed a no-host cocktail hour followed by a roast beef buffet. Following dinner, 14 lucky persons won door prizes of fine California wine; music, dancing, and small talk were in order and the hardy closed the banquet hall at 1:00 a.m. Music was provided by Roy Arimoto's Good Times Show.

Wednesday was half a day of paper sessions and a business meeting. Wayne Brooks turned the gavel to Denis Burges who will serve as President for the next two years. In the afternoon, 80 members took the opportunity to visit wine country in the Napa Valley. They visited two wineries and enjoyed the beautiful countryside. Despite the heat, everyone survived the day. Others took the opportunity to visit San Francisco, Sacramento, or the nearest swimming pool. The evening was topped off with a chicken barbeque at the Putah Creek Lodge with over 125 attending the affair.

Thursday morning (August 9) was a hectic one for 22 runners who participated in the 5 K Run at 7:00 a.m. The participants and the order of finish are listed elsewhere in the newsletter.

After a half-day of contributed paper sessions and a workshop, the XVIIth annual meeting came to a close on Thursday, August 9. It was time to pack the baggage and go our separate ways. Some caught their planes or drove back home, while others went to Bodega Bay, San Francisco, or places unknown. Some even stayed an extra day in Davis before leaving. All in all, the meeting was successful and the participants learned the latest in the world of Invertebrate Pathology.

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LOST AND FOUND

Nonprescription dark glasses found at the Davis SIP Meeting Barbeque. Contact Harry K. Kaya, Department of Entomol., University of California, Davis, CA 95616.

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PRESIDENTIAL ADDRESS

THE MICROSPORIDIA: 100 YEARS LATER

During the first six months of 1984, I had a most pleasing experience working with Ed Hazard and other members of his staff while I was on a sabbatical at the Gulf Coast Mosquito Research Lab in Lake Charles, Louisiana. It was during this sabbatical that I conceived the idea for my Presidental Address. I was extremely impressed by the work that is being done on various microsporidia of many different kinds of insects and other invertebrates at this lab. It was also a privilege to interact with Dr. Victor Sprague who visited the lab for 3 weeks during the spring. Recent and as yet unpublished studies conducted at this lab made me realize not only how far we have come in our understanding of the microsporidia in recent years but also how much work remains to be done. Thus, I would like to share with you briefly my view of where we are in the field of microsporidiology after 100 years of research.

The title of my talk is based on the fact that the earliest recognition of the microsporidia as a distinct group of organisms occurred about 100 years ago when Balbiani in 1882 proposed the Order Microsporidia for Nosema bombycis, the primary etiological agent of "Pebrine" of the silkworm. A few species of microsporidia had undoubtedly been observed earlier, but only N. bombycis had been named by Naegeli in 1857. I'm certain we are all aware of the historic significance of N. bombycis as a factor in the decline of the silkworm industry in Europe by the mid 1800s and in the investigations of Louis Pasteur on silkworm diseases in the 1860s. According to V. Sprague, by 1899 when Labbe first reviewed the literature on this group of protozoan parasites, there was only one family, three genera, 33 named species and 20 unnamed ones.

In the next 25 years there was an acceleration of interest in the microsporidia which culminated with the famous monograph of Kudo in 1924. The early workers, mostly Frenchmen, were primarily concerned with host-parasite relationships, life cycle studies and species descriptions. Kudo summarized the biology and taxonomy of the groups as it was then known and listed 4 families, 14 genera and about 170 species.

During the next quarter century there was a lull in interest in the microsporidia. In 1947 Weiser recognized only 215 species (an increase of only 45 species in 23 years). At this time the microsporidia were only of academic interest and the limitations of the light microscope and other research equipment seriously hampered their study. Probably the most important observation made during this period was that the polar filament serves as an inoculation needle or tube for conveying the sporoplasm into host cells.

There was a resurgence of interest in the microsporidia during the 1950s which has continued unabated for the last 3 decades. This interest was undoubtedly due to the general flourishing of invertebrate pathology which occurred at this time. The latter was due, in no small measure, to the contributions of Dr. Edward A. Steinhaus - who is the honoree of our Founders Lecture which follows next on the program this morning. At the same time the availability of the electron microscope for conducting studies on the ultrastructure of microsporidia and the use of such approaches as tissue culture and various immunological and electrophoretic techniques to study microsporidia have contributed significantly to this resurgence of interest. In addition, there has been considerable interest in assessing the potential of microsporidia as microbial control agents and, lastly, an increasing awareness of the number of species and their total impact as parasites of animals. In fact, as suggested by Sprague, it doesn't seem unreasonable to propose that the microsporidia may constitute one of the largest groups of animals known when most of the species are some day described.

As evidence of this interest, numerous publications appear yearly that are devoted to microsporidia not only of insects but also most other groups of animals, both vertebrates and invertebrates. The Division on Microsporidia within this Society was formed in 1969 and has sponsored workshops or symposia at every annual meeting since such as the one this year devoted to the "Microsporidia of Vertebrates and Invertebrates other than Insects." A significant portion of the contributed papers at each of our meetings is also concerned with microsporidia, and I'm certain we are all aware of the prominence of microsporidian-related manuscripts published in such journals as the Journal for Invertebrate Pathology, Journal of Protozoology, Protistologia, Acta Protozoologica, Folia Parasitologica and many others. New species and genera are being described at an unprecedented rate. Today we have over 800 known species in about 70+ genera. The last annotated list, containing about 750 named and unnamed species, was compiled by Sprague in 1977; over 25 new genera alone have been proposed in the past 7 years. As recognized by the Society of Protozoologists in 1980, perhaps the best indication of the prominence that this group of protozoans has achieved was their elevation in 1977 to the rank of phylum by Sprague.

After over 100 years of study, one might think that at least we have come up with a stable and natural system of classification of the microsporidia. Indeed, two new classifications were recently proposed, almostly simultaneously, by Sprague and Weiser in 1977; however, after spending 6 months in Hazard's laboratory, personally visiting with Sprague and reading some of the most recent literature, it is clear that neither of these classifications is satisfactory. In fact, even in retirement, Sprague is working diligently with Hazard to develop a more natural system of classification which will be based on various features present or absent in the life cycles of microsporidia. Emphasis will be placed on the occurrence or lack of diplokarya in merogonic stages and the presence of sexual forms with one or more sporulation sequences during sporogony or the absence of sexuality during sporulation. Such a system based on nuclear phenomena should serve as a basis for indicating natural relationships and would allow one to include such dimorphic genera as Amblyospora, Parathelohania or Vairimorpha which do not presently fit well into the systems of Sprague or Weiser.

Efforts to develop a sound system of classification have focused attention on recent discoveries in microsporidian life cycles. Perhaps a central question to many of the observations on life cycles pertains to the significance of meiosis in microsporidian sexuality. Since the initial demonstrations of synaptonemal complexes in microsporidia by Loubes and also Vavra, meiosis leading to the production of haploid spores has been amply demonstrated in the life cycles of several species of microsporidia from mosquitoes, black flies, and even a lepidopteran. Almost without exception, these halpoid spores have proven to be noninfectious perorally and have led to speculations that karyogamy might occur in an alternate or intermediate host. However, in two species of microsporidia of the genus Vairimorpha, several workers have presented evidence that points to the distinct possibility that meiospores are infectious. If this is the case, then the uninucleate sporoplasms must form gametes early in the life cycles in a new host. These would fuse to form a diplokaryon whose nuclei would subsequently undergo karyogamy and meiosis. I should like to emphasize, however, that convincing evidence for this occurring in Vairimorpha has not been obtained nor is there any proof yet that gametogenesis occurs in an alternate or intermediate host species. In fact, Hazard has shown that meiosis in several species of microsporidia from mosquitoes is very unlike classical meiosis and the resulting meiospores appear to be nonfunctional. In numerous other microsporidia, evidence has also been obtained that meiosis is extremely aberrant and most sporonts abort prior to sporulation. Thus, meiosis as a sexual process in many microsporidia may only be a relic that was at one time a functioning sexual cycle.

Along with efforts to understand the significance of meiosis, several investigators have also concentrated on understanding the complex life cycles of many of the microsporidia whose development may be dimorphic or even polymorphic. Dimorphic development is well exemplified in Amblyospora where binucleate spores in adult female mosquitoes extrude sporoplasms which infect developing eggs and result in transovarian transmission. In male and sometimes in both larval sexes depending upon the species, sporogony involving meiosis results in the production of haploid spores or meiospores in the next generation. These infections are usually fatal. In some females which survive to the adult stage, sporogony is delayed until a blood meal is taken and transovarian transmission, presumably, occurs again. An even more complex life cycle involving an Amblyospora-like microsporidium has been worked out by Hazard and his associates for the mosquito, Aedes aegypti. Polymorphic development results in the production of binucleate spores which are responsible for transovarian transmission as well as two types of haploid, uninucleate spores. In this species, meiosis is highly aberrrant and only rarely are meiospores formed. A second type of haploid spore is formed by the disassociation of the nuclei of a diplokaryotic cell to form uninucleate haploid sporonts. These form rosettes that cleave out haploid spores which are infectious perorally to larvae. Gametes have been found in larvae exposed to such spores. These gametes eventually pair by fusion of the cytoplasm to form a diplokaryotic cell which can then give rise to the binucleate spores which effect transovarian transmission. Some of the diplokaryotic sporonts undergo either karyogamy and meiosis or nuclear disassociation to form the two types of haploid spores again. Thus, this appears to be one of few dimorphic or polymorphic microsporidia from mosquitoes whose entire life cycle has been completely worked out.

The phenomenon of nuclear disassociation where the two nuclei of a diplokaryotic cell separate and two uninucleate cells are formed by cytokinesis prior to sporogony appears to be quite common in many genera which produce uninucleate spores. Certainly this possibility necessitates that future investigators will have to pay closer attention to the early stages of microsporidian infections where gametogenesis, diplokaryon formation, and/or karyogamy and meiosis may occur.

Despite the significant advantages that have derived from the use of the electron microscope, most microsporidiologists are still confronted with the problem of how to separate adequately various species of microsporidia. In recent years there have been several nonclassical attempts to separate microsporidia by conducting electrophoretic and immunological analyses using either whole or disrupted spores. Exospore proteins or disrupted spore polypeptides of several species have been analyzed using the techniques of disc gel electrophoresis, microelectrophoresis and isoelectric focusing, and SDS-polyacrylamide gel electrophoresis. Immunological analyses have involved indirect fluorescent antibody tests, spore agglutination tests and agar gel double immunodiffusion tests. More recently an attempt was made to use the technique of gel electrophoresis in conjunction with a blot immunoassay. To a varying degree, most of these studies were successful in demonstrating the value of such nonclassical techniques in separating microsporidian species, but they have generally been used only with species whose spores could be obtained in abundance. As indicated in one of the contributed papers to be presented at this meeting, these studies have demonstrated the need to develop standardized reagents necessary to provide for reproducible methods for identifying microsporidia. Although the value of these studies to the practicing microsporidiologist may be questionable, we appear to be closer to the prospect of evaluating the immunodiagnostic value of spores, especially as related to the possibility of using monoclonal antibodies for the specific identification of a microsporidium. I think it is also noteworthy that progress along this line will be presented here at this meeting.

From a classical standpoint, species delimitations and determinations still pose a problem to most microsporidiologists. Certainly information on ultrastructure has been of great assistance in describing and separating species but even this technique has it limitations. In many genera, the ultrastructural features of spores and other stages may be quite similar and it is doubtful if any microsporidiologist could provide an identification of a microsporidian species based solely on its morphological or life cycle features without knowing the host species itself. Thus, we are still highly dependent on the old principle of ordinal specificity; and, depending upon the taxonomic group to which the host species belongs, most authors compare their newly described species with other microsporidian species from the same host or closely related species of the same genus. Sometimes this comparison will be extended to those microsporidia described from other genera in the same host family; and, if the microsporidium belongs to a genus which contains relatively few species, perhaps even to the other species of microsporidia in the same genus. Less emphasis has been placed on such features as spore size or shape as taxonomic criteria in recent years while more emphasis is being placed

on the ultrastructural examinations of the details of interactions with host cells as well as of the morphological features of meronts, sporonts and spores. As more and more species are described, this problem of species delimitations will be greatly magnified. And, while we see fewer instances of poorly described species today than 10 to 15 years ago, one can still find species described based on little more than the host identity and site of infection in the host along with spore shape and size of the microsporidium. Such a practice must be strongly discouraged.

In one last comment on taxonomy, there is a tendency today to establish new genera based on characters too narrowly defined, thus resulting in genera with only one or two known species. Often genera are described without knowledge of the full life cycle details of the species, especially the stages in merogony. This practice should be reviewed and a conservative approach taken until authors become more familiar with not only the morphological features of the species but also its life cycle features as verified by experimental transmission whenever possible.

A number of microsporidia have been studied in cell cultures but the potential contributions to microsporidian biology have hardly been scratched. Most studies have been concerned with demonstrating that microsporidia could be grown in tissue explants, primary cell cultures or specific cell lines of habitual or foreign hosts. Thus, techniques have been worked out for limiting contamination and obtaining infection, growth and replication of microsporidia in several types of cultured cells. Spores produced in vitro have also been shown to be infectious for their host organisms. Despite the obvious advantage of using tissue cultures, the high cost of culture media, the low yields in spores, and the relatively infant state of the development of in vitro production techniques presently serve to limit the usefulness of this system in the near future for mass production of microsporidian spores as microbial control agents. However, we are at a point where many of the obstacles to the in vitro study of microsporidia have been overcome. As summarized more fully by Jaronski in 1984, in vitro techniques in conjunction with other techniques can be used in future studies on microsporidian biology, physiology, biochemistry and pathobiology. For example, tissue cultures provide unique opportunities to investigate such questions as the nature of stimuli or other factors involved in initiating sporogony or nuclear and cell division; the influence of host or microsporidian produced hormones; stages involved in intercellular transmission; physiological phenomena such as food acquisition, energy metabolism and biosynethetic pathways; or pathobiologically related events such as metabolic changes in infected cells, host cell defenses and effects on various host cell organelles.

An increasing interest in assessing the potential of microsporidia as microbial control agents has also been apparent during the last 25 years. Through the extensive efforts of Henry and his colleagues, the microsporidium Nosema locustae was registered in 1980 by the United States Environmental Protection Agency for use against grasshoppers. Techniques are now available for the mass production and storage of spores of a number of species of microsporidia, and their persistence under field conditions has been shown to be similar to that of other types of microbial agents with UV protectants significantly enhancing the environmental stability of spores when exposed to UV radiation. Spores can be applied as sprays or formulated as baits for field application. However, due to their relatively low virulence and the chronic nature of most microsporidian infections, there has also been a realization that microsporidia offer the most potential for use against pests with high economic thresholds and in integrated pest management programs. Additional research is needed on developing suitable formulations of spores and novel application techniques to enhance their efficacy against pests of field crops and in aquatic habitats. As the potential safety hazards of relatively few species have been studied for nontarget organisms, greater efforts must also be devoted to assessment of host specificity. Lastly, techniques need to be developed for the rapid and precise identification of specific candidate species to allow for the detection of foreign biotypes in commercial formulations and the differentiation of candidate species from other species occurring naturally in both target and nontarget organisms.

In closing, I would like to emphasize that despite the resurgence of interest in the microsporidia that has been shown in recent years, there is still a great deal to be done. Many basic questions remain about microsporidian biology and the development of a natural system of classification still eludes us. Numerous species also await description. Their assessment as microbial control agents is in an infant state as is their study in tissue culture systems. However, I feel confident that some of the new and exciting discoveries about life cycle developments will allow us to develop a natural system of classification as well as realizing their full potential as microbial control agents. The ubiquitous nature of the microsporidia practically ensures that all of us will encounter them sooner or later in our studies on invertebrate diseases. Thus, it behooves us to stay abreast of developments in the field of microsporidiology, for I submit that its not a matter of whether or not you will become interested in the microsporidia but only a question of when.

Wayne M. Brooks
Davis, August 6, 1984

A WORD FROM THE EDITOR

With this issue, my last one, I have completed two terms as editor of the SIP Newsletter. It has been a rewarding and interesting experience. During this 4-year period I got to know many of you - SIP Officers, Council Members, Regional Correspondents and some other members from around the world - through telephone conversation and correspondence, and at meetings. I would like to thank all those, especially the Regional Correspondents, who have contributed news items about SIP members and feature articles on invertebrate pathology in various parts of the world. Also, I wish to thank our Newsletter Production Staff, especially Mr. Guido Caputo and Mrs. Barbara Cook of my laboratory, and Mrs. Norma Lemieux and Miss Donna Weeks of our Secretarial and Typing Services for doing such a fine job in typing, putting together and mailing the Newsletter.

Dr. Gary G. Wilson of our Institute has agreed to assume the Newsletter editorship starting with the next issue. Dr. Wilson received his B.S.A. in Biology from the University of Saskatchewan, Saskatoon (1965); M.Sc. in Entomology and Microbiology from the University of Manitoba, Winnipeg (1969); and Ph.D. in Insect Pathology and Parasitology from Cornell University, Ithaca (1972). He has been working at the Forest Pest Management Institute, formerly Insect Pathology Research Institute, in the Canadian Forestry Service as a Biologist and later on as a Research Scientist (Protozoology) since 1966. His research interests include the role of microsporidia in the regulation of forest insect populations, and their potential as control agents.

Gary is a member of the American Society of Parasitologists, Canadian Society of Zoologists, Entomological Society of Canada and the Society for Invertebrate Pathology. He was Vice-Chairman of the SIP Division on Microsporida during 1982-84, and is its Chairman for the 1984-86 term. Thus, Dr. Wilson is no stranger to many of you. I am sure he can count on your support and cooperation. You can now send your contributions and news items to Gary. His address is same as mine.

Gary and I, and our other colleagues are looking forward to seeing you here at the SIP Meeting next year.

Sardar S. Sohi