sip newsletter

SOCIETY FOR INVERTEBRATE PATHOLOGY EDITOR: L. P. S. VAN DER GEEST

VOL. IV, NO. 3 JULY 15, 1972

FIFTH ANNUAL MEETING OF THE SOCIETY FOR INVERTEBRATE PATHOLOGY UNIVERSITY OF MINNESOTA, MINNEAPOLIS, U.S.A. 27 AUGUST - 1 SEPTEMBER, 1972

This meeting will be held in connection with the 25th annual meeting of the American Institute of Biological Sciences, and is therefore a Silver Anniversary.

GENERAL INFORMATION

Registration and Reservations. The April Newsletter contained information and forms to send to AIBS for advance registration, and for housing reservations (either hotel or dormitory). Please note that registering with AIBS for the meeting before 15 August saves $10.00. Also, early registrants will receive a complete program in the mail before the meetings. Downtown hotel rooms should be reserved before 31 July. University dormitory rooms are located within walking distance of the meeting rooms; they are less expensive than hotel rooms but naturally do not have so many conveniences.

Parking. Parking of automobiles on campus presents somewhat of a problem. There is adequate space, but it is not in all cases near the residence hall in which you reside. Special large lots are being reserved for visitors.

Airline Passengers. Northwest Orient Airlines is the official carrier for the meetings and offer reduced group rates from various points to Minneapolis. A post-convention tour to the Orient is being offered to meeting participants and their families. Information on flights, reduced fares, and the Orient tour may be obtained by writing to the AIBS Meetings Department, 3900 Wisconsin Ave. N.W., Washington, D. C. 20016.

All commercial airlines use Minneapolis - St. Paul International Airport (Wold-Chamberlain Field) from which the University Campus or downtown Minneapolis can be reached in 20 minutes by taxi or aiport limousine. There will be an information desk in the airport terminal building clearly marked for AIBS meetings, to which you should turn for information and help. Proceed from there to the AIBS headquarters office in Coffman Memorial Union on the Minneapolis Campus to get dormitory room assignments, registration badges, and other information, if you do not have a room reservation. Local arrangements committees are planning to have shuttle buses or station wagons available to help transport people and luggage between Coffman Memorial Union and the dormitories.

Weather. The weather is unpredictable in Minneapolis because this is in the center of a large continent. Typically both days and nights are very warm (upper 80's F) with high relative humidity and very little rain. However, be prepared for rain, for cool nights, and even extremely hot daytime temperatures (middle 90's F) — the weather is variable.

Meeting Location. The Society has been assigned meeting rooms in three buildings in the chemistry-pharmacy complex near the east bank of the Mississippi River. The main meeting area is Appleby Hall, with some meetings in Kolthoff Hall and some in the Science Classroom Building.

Field Trips. A field trip of interest to invertebrate pathologists and protozoologists is sponsored jointly to visit the National Water Quality Laboratory on the shore of Lake Superior at Duluth, in northern Minnesota. Please send reservations in advance if possible, or sign up early in Coffman Memorial Union.

FOR SPECIAL HELP

For particular problems or questions in advance, write to Dr. Marion A. Brooks, Department of Entomology, Fisheries, & Wildlife, University of Minnesota, St. Paul, Minnesota 55101. Upon arrival, for help with transportation, questions, information, etc., please call 373-1736, 373-1738, or 484-7062

GENERAL PROGRAM

Sunday, August 27

2:00 PM SIP Executive Council Meeting. C. Vago, President, presiding. Coffman Memorial Union 354.

8:00 PM SIP Executive Council Meeting (continued). Coffman Memorial Union 354.

Monday, August 28

9:00 AM - 12:00 NOON
SESSION 1, Contributed papers, Physiopathology. L. Bailey, presiding. Appleby Hall 150.

9:00 AM - 12:00 NOON
SESSION 2, Contributed papers, Physiopathology. Jack T. Cecil, presiding. Appleby Hall 350.

2:00 PM - 5:00 PM
SESSION 3, Contributed papers, Physiopathology. H. M. Mazzone, presiding. Appleby Hall 150.

Tuesday, August 29

8:30 AM - 12:00 NOON
SESSION 4, Invited papers, Symposium on Invertebrate Immunology. Edwin L. Cooper, presiding. Appleby Hall 150.

2:00 PM - 4:45 PM
SESSION 5, Invited papers, Symposium on Invertebrate Immunology (continued). Appleby Hall 150.

2:00 PM - 4:45 PM
SESSION 6, Workshop on Microspiridia. Ann Cali, presiding. Appleby Hall 350.

5:00 PM - 6:30 PM
Reception (sherry and finger sandwiches) for all members of SIP and symposium speakers. Campus Club, 4th floor of Coffman Memorial Union. Hosts: International Minerals & Chemical Corp., Nutrilite Products, Inc. and Thompson-Hayward Chemical Co.

7:30 PM - 10:00 PM
SESSION 7, Workshop on Fungal Epizootiology. Don W. Roberts, presiding. Appleby Hall 150

Wednesday, August 30

8:00 AM - 11:00 AM
SESSION 8, Symposium on Invertebrate Immunology (continued). Appleby Hall 150.

9:00 AM - 10:00 AM SIP Executive Council Meeting. C. Vago, President, presiding. Kolthoff Hall S138.

10:00 AM - 11:00 AM SIP Business Meeting. C. Vago, presiding. Science Classroom Building 325.

11:00 AM - 12:00 NOON SIP Plenary Session and Presidential address, John D. Briggs.

2:00 PM - 5:00 PM
SESSION 9, Contributed papers, Physiopathology. Elizabeth W. Davidson, presiding. Appleby Hall 350.

2:00 PM - 5:00 PM
SESSION 10, Symposium on Invertebrate Immunology (concluded). Appleby Hall 150.

Thursday, August 31

9:00 AM - 12:00 NOON
SESSION 11, Contributed papers, Physiopathology, presiding officer to be appointed, Kolthoff S132.

9:00 AM - 12:00 NOON Working Group on the Safety of Microbial Control Agents. Marshall Laird, presiding. Kolthoff S133.

2:00 PM - 5:00 PM
SESSION 12, Silver Anniversary Symposium. Invited papers: Projections for the future of invertebrate microbiology and pathology. Marion A. Brooks, presiding. Science Classroom Building 325.

6:00 PM - 10:00 PM Social hour and Banquet
6:00 - 7:30 — Cash bar
7:30 - 10:00 — Dinner
University Club (not affiliated with University of Minnesota), 420 Summit Ave., St. Paul. Transportation by chartered bus. Partial cost of dinner

donated by: Internation Minerals & Chemical Corp., Nutrilite Products, Inc. and Thompson-Hayward Chemical Co.

Friday, September 1 7:30 AM - 7:00 PM

FIELD TRIP, to National Water Quality Laboratory and University of Minnesota Limnology Laboratory, North Shore of Lake Superior, Duluth. Buses depart from Society Headquarters, Kolthoff Hall, at 7:30 AM and return at 7:00 PM. Transportation and box lunch, $8.00.

ABSTRACTS OF PAPERS

Monday Morning, August 28. SESSION 1, L. Bailey, presiding. Appleby Hall 150.

9:00 - 9:15 THOMPSON, CLARENCE G. Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331. Studies of the Epizootiology of Nuclear Polyhedroses of the Douglas-fir Tussock Moth.

Epizootics of nuclear polyhedroses have been studied in 13 populations of the Douglas-fir tussock moth, Hemerocampa pseudotsugata McD., during the past nine years in a geographical area ranging from Washington and Montana in the north to Arizona and California in the south. A bundle-virus (BV) nuclear polyhedrosis appears to be characteristic of northern epizootics while a single-virus (SV) nuclear polyhedrosis is characteristic of central and southern epizootics. Similar, or perhaps identical, BV and SV nuclear polyhedroses have been found in two other species of tussock moths in the northern part of the range, which may contribute to a virus reservoir. The BV nuclear polyhedroses have been found to occur in distinct strains which can be distinguished by their characteristic polyhedra shapes. Some strains are markedly more virulent than others. Epizootics can be predicted by the prevalence of virus associated with egg masses, although the presence or absence of polyhedrosis in the larval population in the year preceding the wide-spread epizootic is not a reliable indicator. Variations in the prevalence of polyhedrosis in the early instars are more important in determining the speed at which an epizootic develops than in their effect upon the eventual outcome.

9:15 - 9:30 SMIRNOFF, W. A. Canadian Forestry Service, Laurentian Forest Research Center, 1080 Route du Vallon, P.O. Box 3800, Ste Foy, Quebec 10, P. Q., Canada. Ecology of the Neodiprion swainei virus.

Several factors may affect the pathogenicity of the nuclear-polyhedrosis virus, "Baculovirus swainei," which has been used for control of Neodiprion swainei, a serious defoliator of jack pine. The freezing of aqueous polyhedral suspension, solar radiation and the alkalinization of polyhedral suspensions observed during putrefaction of larvae decreased the efficacy of the virus. However, polyhedra can be preserved by maintaining the pH value of the suspensions between 6.0 and 7.0 or by lyophilization. The volatile substances released by foliage of jack pine do not affect pathogenicity. Larval development rates and ambient temperature interact to affect considerably the pathogenicity of this polyhedral virus disease which is specific to N. swainei; susceptibility decreases with larval age and the optimum temperature for disease development is between 22 and 25 C. Infection of older larvae permits the transmission of the virus to progeny. Other microorganisms (bacteria, microsporidia, flagellates) only slightly affect virus development. Also, it was observed that the virus disease enhances the formation of cysts in eonymphs and adults. The addition of glutamic acid or traces of cobalt nitrate to foliage, or fertilization of jack pine with 400 pounds of nitrogen (urea) per acre, increased the susceptibility of the insect to viral infection.

9:30 - 9:50 BIRD, F. T. (1), CUNNINGHAM, J. C. (1) and HOWSE, G. M. (2). Insect Pathology Research Institute, P.O Box 490, Sault Ste Marie, Ontario, Canada (1) and Great Lakes Forest Research Centre, P.O. Box 490, Sault Ste Marie, Ontario, Canada (2). Highlights of the Spruce Budworm Virus Research Programme.

The poxvirus and nuclear-polyhedrosis virus of the spruce budworm were mass-produced in the winter season 1971-2. Two and a half million larvae were reared on synthetic diet in plastic cream cups, sprayed with virus, harvested when heavily infected and freeze-dried. In 1971 both poxvirus and nuclear-polyhedrosis virus were applied on budworm infested white spruce and balsam fir trees using a helicopter fitted with boom and nozzle spray equipment and in 1972 with a fixed-wing aircraft fitted with micronaire equipment. A total of 50 acres were sprayed in 1971 with aqueous suspension of viruses formulated with IMC sunlight protectant and 2,000 acres in 1972 with viruses formulated with IMC sunlight protectant, molasses and Biofilm. Application rates of 1, 2 and 3 gallons per acre were tested with various concentrations of the viruses. The impact of the viruses on the spruce budworm population was studied

by determining the percentage virus infection and by quantitative population reduction counts. Studies were also made to determine if either of the viruses was transmitted from one year to the next and if spread occurred after the initial introduction.

9:50 - 10:05 HARPER, JAMES D. (1) and ABRAHAMSON, LAWRENCE (2). Department of Zoology - Entomology, Auburn University, Auburn, Alabama 36830 (1) and U. S. Forest Service Southern Hardwoods Laboratory, Stoneville, Mississippi 38776 (2). Field Testing of Microbial Insecticides for Control of Malacosoma disstria in Southwestern Alabama.

The forest tent caterpillar has annually defoliated an average of over 20,000 acres of tupelo gum (Nyssa aquatica) forest in the Mobile-Tensaw river basin of southwest Alabama. Methods for controlling this defoliation with minimum contamination to the immediate environment are needed. Two commercial strains of Bacillus thuringiensis, a nuclear polyhedrosis virus, and an entomophthoran fungus were utilized as candidate insecticides in tests carried out in the spring of 1972. Dylox was used as an insecticide standard. Materials were applied by fixed wing aircraft to 20-acre blocks of tupelo gum. Techniques used in selecting, marking, treating, and evaluating plots will be discussed. Several B. thuringiensis treatments compared favorably with Dylox but neither virus nor fungus was effective under the conditions of the test.

10:05 - 10:25 SMIRNOFF, W. A. Canadian Forestry Service, Laurentian Forest Research Center, 1080 Route du Vallon, P.O. Box 3800, Ste Foy, Quebec 10, P. Q., Canada. Field Investigation of Bacillus thuringiensis with chitinase against Choristoneura fumiferana.

The addition of traces of enzyme chitinase in Bacillus thuringiensis preparations permitted easier penetration of Bacillus thuringiensis spores into the hemolymph; chitinase hydrolyzed the chitin layer of the insect gut. During spring, 1971, three 100 acre plots were established in balsam fir stands severely infested by spruce budworm: Plot 1 was sprayed with Thuricide HPC + chitinase; Plot 2 with Thuricide HPC alone; and Plot 3 served as control. Spraying was from a Stearman aircraft equipped with Micron-air sprayers. In Plot 1 mortality was 93%, in Plot 2, 85%, and in Plot 3, 54%. The results of defoliation were: Plot 1, 24% buds completely destroyed, 36% partially destroyed, 39% intact; Plot 2, 65% of the buds completely destroyed, 31% partially destroyed, 4% intact; Plot 3, 86% completely destroyed, 12% partially destroyed, 1% intact. It was also established that B. thuringiensis survived for 17 days in the air and 30 days on foliage of treated plots, and that no residual particles remained in the air from the operation.

10:25 - 10:40 THOMAS, E. DAVID. Entomology Department, University of Maryland, College Park, Maryland 20742. Labor Saving Devices for Laboratory Production of Nuclear Polyhedrosis Viruses of Spodoptera frugiperda and Heliothis zea.

The cannibalistic nature of the larvae of Spodoptera frugiperda and Heliothis zea necessitates that the larvae be reared individually. To produce nuclear polyhedrosis viruses (NPV) of these insects economically and in sufficient quantities for laboratory and field testing, labor saving devices were designed to reduce time and labor in the rearing and inoculating procedures. The dispensing of the larval diet into individual rearing containers, transferring newly emerged larvae onto the diet and inoculating the diet surface of the developing larvae with NPV suspensions have been mechanized.

10:40 - 10:55 RECESS

10:55 - 11:10 BEEGLE, C. C. (1) and OATMAN, E. R. (2). Department of Entomology & Zoology, Iowa State University, Ames, Iowa (1) and Division of Biological Control, University of California, Riverside, California (2). Differential Susceptibility of Parasitized and Nonparasitized Trichoplusia ni Larvae to a Nuclear Polyhedrosis Virus.

Nonparasitized second instar Trichoplusia ni larvae were found to be twice as susceptible (at the LD_{50} level) to the singly enveloped T. ni nuclear polyhedrosis virus than were those parasitized by Hyposoter exiguae (Viereck) (Hymenoptera: Ichneumonidae). The LD_{50} values for nonparasitized and parasitized larvae were 1.58×10^3 and 3.16×10^3 polyhedra/ml of diet respectively. The LD_{95} value for parasitized larvae was approximately 5 times higher than that for nonparasitized larvae. The slopes (b values) were 1.2 for parasitized larvae and 1.7 for nonparasitized larvae. The LT_{50} values for parasitized larvae also were significantly longer than those for nonparasitized larvae. No significant difference was found between the food consumption of parasitized and nonparasitized T. ni larvae; thus the above differences cannot be explained on the basis of differences of food consumed by the two groups. Possible reasons for the above differences and then possible importane in biological control will be discussed.

11:10 - 11:25 SETO, DAWN S. and ORLOB, G. B. Department of Botany, University of Toronto, Toronto 181, P. O., Canada. Effects of a Granulosis Virus on a Non-Host Insect.

We have studied the effects of a granulosis virus from Pieris rapae (L.) on an insect outside its natural host range. Inclusion bodies (IB), inclusion body proteins (IBP), and free virus (GV) were isolated and sprayed on, fed to, or injected into apterous Myzus persicae (Sulz.). After ingestion intact IB were seen in the lumen and near the microvilli of the midgut. No release of GV from capsules or virus entry into midgut cells was observed. Honeydew of aphids fed on IB was infectious. IB, IBP, and GV increased mortality when fed to or injected into aphids. However, no evidence for virus multiplication in treated aphids could be obtained.

11:25 - 11:45 BAILEY, L. Bee Department, Rothamsted Experimental Station, Harpenden, Herts, England and Department of Plant Pathology, University of Arkansas, Fayetteville, Arkansas 72701. The Resistance of Bees to Virus Infections.

Honey-bees do not acquire humoral immunity to virus diseases. For example, many adult bees are inapparently infected with one or both of their paralysis viruses, but they die of paralysis when only a few particles of either virus are injected into their haemolymph. The mechanisms that usually contain the natural inapparent infections of bees with paralysis viruses seem to be controlled largely by hereditary factors. By contrast, the bee community resists the spread of sacbrood virus, at least partly, by several changes in the otherwise normal behaviour of infected adults. For example, most young infected adults fail to tend larvae, and most infected foragers do not collect pollen. The small proportion of infected adults that do gather pollen, deposit much sacbrood virus into their loads which may well be a source of infection for young susceptible individuals. These eat much pollen and feed larvae which invariably die when infected by the virus.

Monday Morning, August 28 SESSION 2, Jack T. Cecil, presiding. Appleby Hall 350.

9:00 - 9:15 FARRENS, B., KREUZER, R. and HAMLIN, L. University of San Diego, Camino Hall, Box 264, Biology Department, San Diego, California 92110. Lethality of Hemocoelomic Infection in Tenebrio molitor: A Comparative Study of Colpoda, A Cyst Forming Protozoan, and Tetrahymena pyriformis.

Tenebrio molitor is an ideal organism for in vivo studies of host-parasite interaction. We have demonstrated in our earlier experiments that Tetrahymena pyriformis can be introduced as an infectuous parasite into the hemocoele of T. molitor with peak parasitemia between 5-8 days. Infection is prolonged by inducing division delay with ultraviolet light thus permitting extended observation of the infective mechanism. In

this study we have cultured two species of the cryptobiotic ciliate, Colpoda, one from fresh water and the other from a skink. The parasitic Colpoda survive and excyst in T. molitor becoming engorged with fat globules in a manner similar to that of Tetrahymena. Tetrahymena and Colpoda parasitemia parallel each other for a period of 48 hours at which time the Colpoda appear to encyst. Our current research seems to indicate that these cyst forming ciliates manifest a different pattern of parasitemia than non-cryptobiotic forms.

9:15 - 9:35 RICHARDS, CHARLES S. Laboratory of Parasitic Diseases, National Institute of Allergy & Infectious Diseases, National Institutes of Health, Bethesda, Maryland 20014 (Building 5 - Room 114). Insusceptibility of Biomphalaria glabrata for Infection with Schistosoma mansoni.

The host-parasite relationship between Biomphalaria glabrata and Schistosoma mansoni involves variations in susceptibility in the snail and variation in infectivity in the trematode. Our studies have involved self-fertilization of isolated B. glabrata, selection on the basis of suceptibility or insusceptibility of both juvenile and adult snails to S. mansoni, and crosses to determine the quantitative and qualitative characteristics of the genetic factors involved. Results to date indicate that strains of S. mansoni tested fall into at least two groups on the basis of their infectivity. Results of exposures of both juvenile and adult B. glabrata suggest occurrence of at least eight genetic factors affecting susceptibility, resulting in seven different susceptibility combinations. In our studies tissue reaction was not observed in most refractory snails. Failure of the parasite to develop could be due to presence or production of an inhibitory factor, or deficiency of a parasite requirement.

9:35 - 9:50 CHRISTIE, JOHN D., FOSTER, WILLIAM B. and STAUBER, LESLIE A. Department of Zoology, Rutgers University, New Brunswick, New Jersey. The Effect of Parasitism and Starvation on Carbohydrate Reserves of Biomphalaria glabrata.

This study was undertaken to investigate changes in carbohydrate levels of organs of B. glabrata parasitized by Schistosoma mansoni and to see if these changes could be mimicked by starvation of the snail. Snails parasitized by S. mansoni showed an increase in relative weight of the digestive gland-gonad complex and a decrease in glycogen in that complex and in the remainder of the carcass by day 25. Glycogen levels further decreased close to zero and remained at this low level for the duration of the experiment. Relative weight of the digestive gland-gonad reached a peak at day 30 and decreased toward normal by day 40. Galactogen levels in the albumen gland,

although decreased slightly, were not significantly lower than in normal animals. In the starvation experiments, glycogen and galactogen levels decreased significantly below normal at day 21. These low levels were maintained until days 31-32 when mass mortality of the starved snails occurred. This study demonstrates the severe changes in carbohydrate levels of parasitized snails and raises the possibility that starvation of the host by the parasite may play a significant role in the pathology observed in this infection. (This work was supported in part by PHS Training Grant No. A1-187 from NIAID and by Biological Sciences Support Grant 1971-72.)

9:50 - 10:05 SULLIVAN, JOHN T. and CHENG, THOMAS C. Institute for Pathobiology, Lehigh University, Bethlehem, Pennsylvania 18015. Effect of Copper on the Respiration of Biomphalaria glabrata (Mollusca: Pulmonata).*

Copper, primarily in the form of copper sulfate, has been employed empirically for decades as a molluscicide against the snail intermediate hosts of the human-infecting schistosomes. In our studies we are attempting to elucidate the physiological effects of copper on Biomphalaria glabrata, the molluscan intermediate host of Schistosoma mansoni. Concentrations of copper well below those applied in the field exert a rapid and irreversible depression of the respiratory rate of whole specimens of B. glabrata, eventually leading to death of the snail. This depression has been observed not only with copper sulfate but also with several other experimental molluscicidal copper compounds. Nonmolluscicidal copper compounds do not exert this respiratory inhibition. It is proposed that respiratory inhibition effected by a candidate copper-containing molluscicide is an index of the cidal properties of the compound.

10:05 - 10:20 SULLIVAN, JOHN T. and CHENG, THOMAS C. Institute for Pathobiology, Lehigh University, Bethlehem, Pennsylvania 18015. Heart Rate as a Bioassay Method for the Cidal Effects of Copper Compounds on Biomphalaria glabrata (Mollusca: Pulmonata).*

Copper in various concentrations (0.1 - 20 ppm) has been found to exert a rapid depression on the heart rate of Biomphalaria glabrata, the snail intermediate host of Schistosoma mansoni. Not only copper sulfate but also several other experimental molluscicidal copper compounds display this effect. Nonmolluscicidal copper compounds do not exert this inhibition. Mortality studies indicate that snails do not recover from this depression in heart rate when exposed to concentrations of copper above 2 ppm. It is proposed that the effect of a candidate copper-containing molluscicide on the heart rate of B. glabrata is an index of the toxicity of the compound to the snail and one that may be employed in preliminary laboratory screening of potential molluscicides. (* Supported in part by a grant INCRA 193 from the International Copper Research Association.)

10:20 - 10:40 RECESS

10:40 - 11:00 FOLEY, DAVID A. and CHENG, THOMAS C. Institute for Pathobiology, Lehigh University, Bethlehem, Pennsylvania 18015. Morphology and Phagocytic Behavior of Hemolymph Cells of Mercenaria mercenaria.

As a continuation of our studies on the interaction of molluscan hemolymph cells with foreign agents, we have conducted some observations on the behavior and phagocytic activity of cells of the quahaug clam, Mercenaria mercenaria. Studies on living and fixed leucocytes drawn from the adductor muscle sinuses of M. mercenaria showed them to be of two types: granulocytes and fibrocytes. The granulocytes include large numbers of irregular granules in the endoplasm while the fibrocytes include few or no granules in their cytoplasm, as well as extensive pseudopodia. Both types of cells are amoeboid and have two prominent features in common: (1) they both include semi-rigid, rodlike structures extending from the endoplasm out beyond the ectoplasm, and (2) there are ectoplasmic sheaths stretched between the rods. The granules of living granulocytes stain strongly with Neutral Red, Brilliant Cresyl Blue, and Janus Green B (all at 0.005% final concentration) while those in fibrocytes do not. In vitro experiments have shown that M. mercenaria leucocytes will phagocytize Bacillus megaterium from a suspension, in hanging drop preparations, but the phagocytic index of granulocytes is significantly greater than that of fibrocytes. (Supported in part by Grant FD-00416-01 from the U. S. Public Health Service.)

11:00 - 11:20 FOLEY, DAVID A. and CHENG, THOMAS C. Institute for Pathobiology, Lehigh University, Bethlehem, Pennsylvania 18015. Degranulation of Leucocytes of Crassostrea virginica and Mercenaria mercenaria in vitro.

A gradual degranulation of certain granulocytes of Crassostrea virginica and Mercenaria mercenaria has been observed in living preparations in vitro. This results in the transformation of granulocytes to vacuolated, nearly agranular cells. As a consequence, we are of the opinion that the vacuolated, agranular cells observable in fixed and stained preparations of C. virginica leucocytes designated as "secondary fibrocytes" (Foley and Cheng, 1972. J. Invert. Pathol., 19:383-394) have their origin as degranulated granulocytes. This hypothesis is further supported by differential counts of C. virginica hemolymph cells that have been permitted to remain on glass slides for varying periods of time prior to fixation. Such counts have revealed a decrease in the number of granulocytes concurrent with an increase in the number of secondary fibrocytes as a function of time. A partial degranulation of M. mercenaria

granulocytes after they have phagocytized Bacillus megaterium in vitro has been observed. In view of our finding of the degranulation process, future quantification of molluscan leucocytes should be designed to take this phenomenon into consideration. (Supported in part by Grant FD-00416-01 from the U. S. Public Health Service.)

11:20 - 11:35 QUICK, J. A., JR. FDNR Marine Research Laboratory, P.O. Drawer F, St. Petersburg, Florida 33731. A New Thraustochytrideacous Fungus Endoparasitic to the American Oyster, Crassostrea virginica Gmelin, in Florida.

A new oyster parasite, Thraustochytrium inglei n. sp., was isolated on bovine serum sea water agar culture medium from tissues of oysters collected in Cedar Keys, Tampa Bay, and Apalachicola Bay, Florida. Heavy infections produce a characteristic histopathology and are the most probable cause of some early summer oyster mortalities. Culture studies confirmed the parasitic nature of this phycomycete and demonstrated its formation of chytroid sporangia with rhizoids, anteriolaterally biflagellate heterokont planonts, and plasmodia. Early aplanospore stages may exhibit a slow labyrinthuloid gliding motility.

11:35 - 11:50 CECIL, JACK T. and NIGRELLI, ROSS F. Osborn Laboratories of Marine Sciences, New York Aquarium, New York Zoological Society, Boardwalk at West 8th St., Brooklyn, New York 11224. Cell Cultures from the Axial Organ of the Sea Stars Asterias forbesi and Asterias vulgaris.

A well developed axial organ is present in all classes of the phylum Echinodermata except the Holothurioidea. This structure has been called dorsal organ, heart, genital stolon, glandular organ, and mysterious gland, as well as other terms. Many different functions have been attributed to the axial organ. Cell cultures of explanted axial organs of the sea stars Asterias forbesi and Asterias vulgaris have been grown in either Leighton tubes or T-35 plastic flasks at 20 C for one month in our laboratory. In 24-72 hours monolayer fibroblast-like cells emerge from the explant. Few mitotic figures are seen in Hematoxylin and Eosin stained preparations. In 48-72 hours epithelial-like granular cells emerge from the explant, or develop from a small focus of cells in the fibroblast-like cellular area. Long and short tailed actively motile cells resembling spermatozoa are located on or near this cell layer. This finding suggests a relationship of the axial organ with the genital stolon. (This research supported by a grant from the Scaife Family Charitable Foundation.)

Monday Afternoon, August 28. SESSION 3, H. M. Mazzone, presiding. Appleby Hall 150.

2:00 - 2:10 REICHELDERFER, CHARLES F. Department of Entomology, University of Maryland, College Park, Maryland 20742. A Hemagglutinating Antigen from a Nuclear Polyhedrosis Virus of Spodoptera frugiperda.

The supernatant from an alkaline digest of a suspension of nuclear polyhedrosis inclusion bodies, centrifued at 100000 x g for 120 minutes, was found to agglutinate adult chicken erythrocytes in a pH range from 5.6 to 6.8. Optimum conditions were determined for active hemagglutination and hemagglutination-inhibition using antiserum made against polyhedral protein. The highest activity was obtained at pH 5.8, with an incubation temperature of 37°C and a digestion time of 45 minutes at pH 10.2. Minimum quantities of antigen detectable by these conditions were at 2 to 4 µg/ml of protein. A comparative study with five nuclear polyhedrosis viruses is considered, as well as further characterization of the antigen.

2:10 - 2:20 APP, A. and GRANADOS, R. Boyce Thompson Institute, 1086 N. Broadway, Yonkers, New York 10701. Effect of Nuclear Polyhedrosis Virus on Polyribosome Content of Gypsy Moth Larvae (Porthetria dispar).

Polyribosomes were purified from whole gypsy moth (Porthetria dispar) larvae and from excised fat body tissue. These polyribosomes were characterized by their sedimentation on sucrose density gradients, their sensitivity to ribonuclease, electron microscopy, and their ability to support in vitro amino acid incorporation. Approximately 85% of the ribosomes purified from gypsy moth tissue were in the polyribosome fraction. Only 40% of these polyribosomes were extracted from the tissue in the absence of 0.5% sodium deoxycholate. There was a steady decrease in the polyribosome content of gypsy moth larvae after infection with nuclear polyhedrosis virus.

2:20 - 2:40 STOLTZ, D. B. Cell Research Institute, University of Texas, Austin, Texas 78712. Comparative Ultrastructural Studies of Invertebrate and Vertebrate Icosahedral Cytoplasmic Deoxyriboviruses.

It has been previously suggested that the icosahedral cytoplasmic deoxyribovirus (ICDV) shell consists of a unit membrane complexed with an icosahedral lattice of morphological subunits (Stoltz, J. Ultrastruct. Res. 37:219, 1971). More recent studies, using purified mosquito iridescent virus (MIV) "top component", suggest a more orthodox model for ICDV structure. This model envisages the ICDV shell as consisting of a modified icosahedral lattice. Observations on the morphogenesis and

structure of both invertebrate and vertebrate ICDV's will also be presented and discussed with reference to the taxonomy and nomenclature of the group.

2:40 - 2:55 STOLTZ, D. B. (1) and PAVAN, C. (2). Cell Research Institute, University of Texas, Austin, Texas 78712 (1) and Department of Zoology, University of Texas, Austin, Texas 78712 (2). Apparent de novo Biogenesis of Nuclear Polyhedrosis Virus Envelopes: Ultrastructural Observations.

The morphogenesis of a unique nuclear polyhedrosis virus in Rhynchosciara angelae (Diptera) will be described. Virus envelopes are almost certainly not derived from nuclear membranes; rather, they appear to arise de novo inside the nucleus.

2:55 - 3:15 McCARTHY, W. J., GRANADOS, R. R. and ROBERTS, D. W. Boyce Thompson Institute, 1086 N. Broadway, Yonkers, New York 10701. Purification and Characterization of Two Insect Poxviruses.

Methods have been devised for obtaining homogeneous preparations of morphologically undamaged virions of two poxviruses of Lepidoptera: Amsacta moorei poxvirus and Chorizagrotis auxiliaris poxvirus. Chemical methods under controlled conditions were employed in the initial release of virus from their inclusion bodies. Examination of these preparations by electron microscopy revealed that Amsacta poxvirus possessed a uniform coat around its outer viral envelope while Chorizagrotis poxvirus possessed knob-like projections around its envelope. Treatment of either virus with trypsin removed these structures. Preparations of Amsacta poxvirus and Chorizagrotis poxvirus both before and after trypsin treatment were characterized according to (1) percent DNA, (2) protein per particle, (3) densities in CsCl, and (4) RNA polymerase activity.

3:15 - 3:30 GRANADOS, ROBERT R., McCARTHY, W. J., ROBERTS, D. W. and SHAPIRO, M. Boyce Thompson Institute, 1086 N. Broadway, Yonkers, New York 10701. Uptake and Development of Amsacta Poxvirus in Estigmene acrea Hemocytes.

The sequence of Amsacta poxvirus uptake and replication was studied in hemocytes of Estigmene acrea larvae following intrahemocoelic injection of purified preparations of virions. Phagocytosis of individual or aggregates of virions took place within 1/4 hr. postinfection, and most virus particles were found in phagocytic vacuoles in the cell cytoplasm after 1 hr. Postinfection degradation of the virions appeared to take place within the vacuoles between 4 and 6 hrs. The release of viral cores into the cell cytoplasm was not observed. Twenty-four hrs. after inoculation, viroplasms

and immature and mature forms of the virus were observed in the cytoplasm. Viral inclusion bodies, virus-induced fibrils, and mature virions extruding from the cell surface were also seen at this time. Only macro- and micro-plasmatocytes were susceptible to virus infection. Viral DNA synthesis in the cytoplasm was demonstrated by using tritiated thymidine and autoradiography. These experiments were carried out concurrently with studies on protein and DNA synthesis in infected hemocytes.

3:30 - 3:50 RECESS

3:50 - 4:05 ADAMS, J. R. and WILCOX, T. A. Insect Pathology Laboratory, USDA, ARS, Room 112, Ent. Bldg. A, #476, ARC, Beltsville, Maryland 20705. Ultrastructural Studies on Invasion and Replication of Polyhedrosis Viruses in the Corn Earworm, Heliothis zea (Boddie).

Early events were observed in the invasion and replication of nuclear and cytoplasmic polyhedrosis viruses following mouth injection and natural feeding of corn earworm larvae. The morphology of the virions, virus precursors in the nucleus and cytoplasm, and the process by which virions are taken into vacuoles and pass through the gut to the tracheal matrix will be described. Multiple embedded virions were observed in the connective tissue surrounding the gut.

4:05 - 4:20 ADAMS, J. R., GOODWIN, R. H., WILCOX, T. A. and VAUGHN, J. L. Insect Pathology Laboratory, USDA, ARS, Room 112, Ent. Bldg. A, #476, ARC, Beltsville, Maryland 20705. Ultrastructural Comparisons of Nuclear Polyhedrosis Virus Replication in Tissue Culture Cells and in the Natural Host.

Similarities and differences in ultrastructural morphology of the nuclear polyhedrosis virus replication process were noted in studies on tissue culture cells and in the natural host of corn earworm, Heliothis zea (Boddie); fall armyworm, Spodoptera frugiperda (J. E. Smith); and cabbage looper, Trichoplusia ni (Hübner). Differences were observed in virus precursors, morphology and numbers of virions, numbers and morphology of polyhedra produced, and quantities of protein accumulated in the nucleus and cytoplasm.

4:20 - 4:35 JENKIN, H. M., YANG, T. K. and ANDERSON, L. E. The Hormel Institute, University of Minnesota, Austin, Minnesota 55912. Comparison of Lipid Composition of Aedes aegypti and Aedes albopictus Cells Cultivated in vitro.

A comparison was made of the lipid composition of established ovarian cells of Aedes aegypti and Aedes albopictus. The cells were cultivated in leafhopper medium (Mitsuhashi, Jap. J. Appl. Ent. Zool. 9:107-114, 1965) containing 20% newborn calf serum employing spinner culture bottles. Lipids of both cell types were extracted toward the end of the log phase of growth (48 - 72 hours). The major lipid differences between the two cells were found in percentages of total lipid, total phospholipid, the free sterols and the fatty acid profiles of sphingomyelin and phosphatidylinositol. The leafhopper medium had a lipid composition distinct from both insect cells, particularly in the triglycerides, sterol esters, phosphatidylcholine and sphingomyelin fractions. The differences in the lipid composition of the two insect cells may correlate with differences in susceptibility to arbovirus infection.

4:35 - 4:50 MAZZONE, H. M. (1) and BAHR, G. F. (2). Forest Insect and Disease Laboratory, Forest Service, U. S. Department of Agriculture, Hamden, Connecticut 06514 (1) and Biophysics Branch, Armed Forces Institute of Pathology, Washington, D. C. 20305 (2). Utilization of the Electron Microscope to Obtain Dry Mass Determinations and Molecular Weight Values of Large Insect Viruses.

A new method is described which uses the electron microscope to obtain the dry mass of large particles in the range 10^{-13} to 10^{-18} g. The photographic plate is processed under standardized conditions of development and fixation together with the micrographs of a weight standard and a magnification standard. The total mass of a particle can be determined by two transmission measurements on its electron micrograph. The plate is evaluated in a photometer which optically interprets the transmission over a defined area containing the image of the object. This area is determined by projecting a physical aperture into the image plane. Next, the transmission of the background density of equal area close to the object is recorded. The difference of the two transmission measurements is an equivalent of the mass. The method is being applied to cataloging mass measurements of large viruses having molecular weights greater than 10^7. Reported at this time are mass measurements and calculated molecular weight values of two insect viruses: the icosahedral tipula iridescent virus and the rod shape virus obtained from the nuclear polyhedrosis of Neodiprion sertifer (Geoffroy).

Tuesday Morning, August 29. SESSION 4, Symposium on Invertebrate Immunology, Edwin L. Cooper, presiding. Appleby Hall 150.

8:30 - 8:45 BROOKS, MARION A. Department of Entomology, Fisheries, & Wildlife, University of Minnesota, St. Paul, Minnesota 55101. Introduction and Welcome.

8:45 - 9:00 COOPER, EDWIN L. Department of Anatomy, University of California, School of Medicine, The Center for the Health Sciences, Los Angeles, California 90024. A Symposium on Invertebrate Immunology: The Past, 1972, and the Future.

9:00 - 9:20 COWDEN, RONALD R. Department of Anatomy, The Albany Medical College of Union University, Albany, New York. Cellular Reactions in Sponges.

9:20 - 9:40 THEODOR, JACQUES. Universite de Paris, Biologie Marine, Laboratoire Arago, 66 Banyuls-Sur-Mer, France. A Tissue Recognition System in Diploblastic Invertebrates.

9:40 - 10:00 SHOSTAK, STANLEY. Department of Biology, University of Pittsburgh, Pittsburgh, Pennsylvania. Graft Responses in Hydra.

10:00 - 10:10 DISCUSSION

10:10 - 10:30 RECESS

10:30 - 10:50 DUPRAT, PIERRETTE. Centre National de la Recherche Scientifique, Laboratoire de Morphologie Experimentale, Institut de Biologie Animale, Talence 33, France. Mechanisms of Self Protection and Immune Defense in Earthworms.

10:50 - 11:10 HOSTETTER, RUSSELL K. Department of Anatomy, School of Medicine, University of California, Los Angeles, California 90024. Cellular Kinetics in Earthworm Graft Rejection.

11:10 - 11:30 LEMMI, CARLOS. Department of Anatomy, School of Medicine, University of California, Los Angeles, California 90024. Activity of ^{51}Cr Labelled Earthworm Coelomocytes.

11:30 - 11:50 HILDEMANN, WILLIAM H. Department of Medical Microbiology and Immunology, School of Medicine, University of California, Los Angeles, California 90024. Transplantation Immunity in Echinoderms.

11:50 - 12:00 DISCUSSION AND SUMMARY OF MORNING SESSION.

Tuesday Afternoon, August 29. SESSION 5, Immunology (continued). Appleby Hall 150.

2:00 - 2:15 STANG-VOSS, C. Anatomisches Institut der Albert-Ludwigs-Universität, 78 Freiburg Im Breisgau, Albertstrasse 17, West Germany. On the Ultrastructure of Invertebrate Hemocytes: An Interpretation of their Role in Comparative Hematology.

2:15 - 2:30 BAERWALD, ROY J. Department of Pharmacology, School of Medicine, Box 875, Biscayne Annex, University of Miami, Miami, Florida 33152. A Freeze Etch Study of Hemocyte Membranes Involved in the Encapsulation Reaction.

2:30 - 2:45 ANDERSON, ROBERT S. Research Laboratories of The Variety Club Heart Hospital, Department of Pediatrics, University of Minnesota, Minneapolis, Minnesota 55455. Metabolism of Insect Hemocytes During Phagocytosis.

2:45 - 3:00 HILGARD, HENRY R. Division of Natural Sciences, University of California, Santa Cruz, California 95060. Analysis of Receptor Specificity of Sea Urchin Coelomocytes.

3:00 - 3:15 DISCUSSION

3:15 - 3:30 RECESS

3:30 - 3:50 HINK, W. FRED. Department of Entomology, The Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210. The Interaction of Wax Moth Hemocytes with Foreign Cells in vitro.

3:50 - 4:10 NAPPI, A. J. Department of Biology, State University College, Oswego, New York 13126. Hemocytic Changes Associated with Insect Immunity with Reference to Possible Mechanisms Controlling the Activation of the Immune Response.

4:10 - 4:30 UNESTAM, TORGNY, NYHLÉN, LARS and AJAXON, RAGNAR. Uppsala Universitet Institution for Fysiologisk Botanik, 751 21 Uppsala, Sweden. On Cellular and Non-Cellular Recognition of Fungi in Crayfish.

4:30 - 5:00 DISCUSSION AND SUMMARY OF AFTERNOON SESSION.

5:00 - 6:30 RECEPTION. Campus Club, Coffman Memorial Union.

Tuesday Afternoon, August 29. SESSION 6, Ann Cali, presiding. Appleby Hall 350.

2:00 - 2:20 NORDIN. G. L. and MADDOX, J. V. Department of Entomology, University of Kentucky, Lexington, Kentucky 40506 and Illinois State Natural History Survey, U. of Ill., Urbana. Microsporidia of the Fall Webworm, Hyphantria cunea, in Illinois.

Investigations were conducted on the occurrence and distribution of naturally occurring microsporidia pathogenic to wild populations of the fall webworm, Hyphantria cunea, in Illinois in 1970. Three species of microsporidia were recovered from field collected larvae. Two of these species were identified as Nosema necatrix Kramer and Pleistophora schubergi hyphantriae Weiser while the third species differed from all previously described species of Nosema. The name Nosema trichoplusiae hyphantriae has been proposed. The suggested life cycle of N. trichoplusiae hyphantriae was developed by studying Giemsa-stained slides prepared from infected tissue. Histopathological investigations revealed the sequence and intensity of infection in susceptible tissues. Ten species of Lepidoptera were susceptible to N. trichoplusiae hyphantriae infection, but a dipteran, Phormia regina, and a hymenopteran, Neurotoma inconspicua, were not infected. Transovarial transmission of N. trichoplusiae hyphantriae was demonstrated in Estigmene acrea. Direct comparative studies were done between N. trichoplusiae hyphantriae and N. trichoplusiae Tanabe and Tamashiro, a previously described Nosema which most closely resembled N. trichoplusiae hyphantriae.

2:20 - 2:40 UNDEEN, ALBERT H. Department of Zoology, University of Illinois, Urbana, Illinois 61801. The Use of Unusual Hosts to Produce Large Numbers of Nosema algerae Spores.

Insects of several different orders are susceptible to Nosema algerae if the spores are injected into the hemocoel. A large lepidopterous larva such as the corn earworm can be easily reared in the laboratory and produce far more spores than a mosquito (the normal host) which is more difficult to maintain. An unusual host may be used to rear large quantities of spores for tests of biological control of mosquitos or for maintenance of the parasite in the laboratory. Spores produced in all unusual hosts appeared to be as infective for mosquitos as spores from mosquitos. Size of

spores from unusual hosts and polar filament extrusion parameters were the same as spores from the normal host.

2:40 - 3:00 KURTTI, TIMOTHY J. Department of Entomology, Fisheries, & Wildlife, University of Minnesota, St. Paul, Minnesota 55101. Effect of Fumagillin on Microsporidia-infected Malacosoma disstria, and on Cultured Cells of M. disstria and Heliothis zea.

3:00 - 3:20 ČERKASOVOVÁ, APOLENA and VÁVRA, JIŘÍ. Institute of Parasitology, Czechoslovak Academy of Sciences, Prague, Czechoslovakia. Disintegration of Microsporidian Spores for Physiological Studies. (To be read by Ann Cali).

Several authors have reported difficulty in disintegrating microsporidian spores for physiological or immunological studies. The most successful method so far described consists of grinding the spores in the presence of solid CO_2. However, in our experience this method yields only a very low percentage of disrupted spores and is rather laborious. For this reason we have undertaken a comparative study of methods for disintegration of spores of Nosema plodiae. The following methods were tried: 1) grinding of spores in a mortar in the presence of powdered glass, 2) grinding of spores in a mortar with solid CO_2, 3) mortar grinding of spores previously frozen with liquid nitrogen, 4) repeated freezing of spores in liquid nitrogen and thawing, 5) homogenization in a tissue grinder according to Potter-Elvehjem, 6) disintegration of spores in suspension with very fine glass beads ("ballotins", diameter approx. 0.1 - 0.2 μ). All methods with the exception of the last one proved rather ineffective or impractical. The disintegration of spores with glass beads, however, proceeds very rapidly and as much as 80-90% of spores are disrupted during 30 - 60 seconds when a suspension of spores and of the beads is spinned by means of a metal ring at 2,000 - 4,000 rpm. The bacteriological ("Burri") ink proved useful for estimation of broken and undamaged spores. The disintegration of spores by means of glass beads does not seem to inactivate the respiratory enzymes of the spores.

3:20 - 3:40 RECESS

3:40 - 3:55 SHADDUCK, JOHN A. (1), POLLEY, MARY B. (1) and CALI, ANN (2). Department of Veterinary Pathology, 1925 Coffey Road, The Ohio State University, Columbus, Ohio 43210 (1) and Department of Pathobiology, Lehigh University, Bethlehem, Pennsylvania (2). Some Biological Properties of the Mammalian Microsporidan Encephalitozoon (Nosema) cuniculi.

The mammalian microsporidan Encephalitozoon cuniculi was isolated from the brain of a rabbit with typical lesions of encephalitozoonosis. The organism was propagated in rabbit choroid plexus cell cultures and a variety of biological properties were studied. The organism replicated in 7 to 10 days and the total number of organisms increased 100 to 500 times in that time. One hundred to 1000 organisms were required for each tissue culture infectious unit. Mice were not more sensitive for titration than rabbit choroid plexus cells. The organism did not replicate in several different insect and fish tissue culture cell lines. The parasite survived a few minutes at 56°C, 10 days at 37°C, 24 days at 20°C. It was inactivated following 10 minutes exposure to 10% neutral buffered formalin, 2% lysol solution or 70% ethyl alcohol but some infectious activity remained after exposure to quaternary ammonia (Roccal) for 120 minutes.

3:55 - 4:05 ORMIÈRES, RENÉ (1) and SPRAGUE, VICTOR (2). Lab. Zoology (Prof. O. Tuzet), Université des Sciences et Techniques du Languedoc, Montpellier, France (1) and University of Maryland, National Research Institute, Chesapeake Biological Laboratory, Solomons, Maryland 20688 (2). A New Family, New Genus and New Species Allied to the Microsporida. (To be read by Dr. Sprague; direct correspondence to him.)

A new and unusual microsporidian species was found in the intestinal epithelium of dipteran larvae of genus Sciara. Merogony is by binary and multiple fission. Sporogonial plasmodia become enclosed in ornate, thick-walled cysts. The cyst contents become cut up by temporary cytoplasmic partitions to make numerous binucleate cells (sporonts). Each divides to produce 1 normal and 1 abortive sporoblast. Because this species has a number of unusual features, a new genus and a new family are proposed to contain it.

Tuesday Evening, August 29. SESSION 7, Don W. Roberts, presiding. Appleby Hall 15

7:30 - 7:45 AOKI, JOJI. Faculty of Agriculture, Tokyo University of Agriculture and Technology, Saiwaicho 3-5-6, Fuchu-city, Tokyo 183, Japan. Some Ecological Factors Influencing Infection of the Pine Shell-Scale Lepidosaphes pini by Red-Headed Scale-Fungus Nectria coccophila.

Natural infection of pine shell-scale by red-headed scale-fungus was investigated on population and individual levels in the field. Both the population of scale insects and the number infected were higher on the slope facing south than on the slope facing north. Levels of infection increased in proportion to population density.

The infection level in a pine grove in the north area was higher than in other parts of the same area, and a similar phenomenon was observed in a crown. The moisture condition was favorable in the north area for fungous infection. The factors regulating the distribution of the scale, i.e. the life of pine needles, might have considerable effect on spread of the fungus. Male immatures in 2nd instar were infected similarly in the first and second generations; however, female immatures were infected in higher numbers in the second generation because of their life cycles and effect of climate thereon.

7:45 - 8:00 SHAPIRO, M. and ROBERTS, D. W. Boyce Thompson Institute, 1086 N. Broadway, Yonkers, New York 10701. In vitro Cultivation of Coelomomyces.

Coelomomyces psorophorae from Psorophora howardii yielded only limited growth, while C. psorophorae from Aedes sollicitans was maintained for three months in cell free media. Fungal material for these studies was dissected from surface-sterilized, infected mosquito larvae and incubated in insect tissue culture media or modified mycoplasma media.

Wednesday Morning, August 30. SESSION 8, Immunology (continued). Appleby Hall 150.

8:00 - 8:20 CHENG, THOMAS C. Institute for Pathobiology, Lehigh University, Bethlehem, Pennsylvania. Molluscan Cellular Immunity.

8:20 - 8:40 BAYNE, C. J. Department of Zoology, Oregon State University, Corvallis, Oregon 97331. Immediate Fate of Bacteria Entering the Land Snail, Helix.

8:40 - 9:00 POINAR, GEORGE O., JR. Division of Entomology, University of California, Berkeley, California. Insect Immunity to Parasitic Nematodes.

9:00 - 9:20 STEWART, JAMES E. and ZWICKER, B. M. Fisheries Research Board of Canada, Halifax Laboratory, P.O. Box 429, Halifax, Nova Scotia, Canada. Induction of Internal Defense Mechanisms of the Lobster, Homarus americanus.

9:20 - 9:40 DISCUSSION.

9:40 - 10:00 RECESS.

10:00 - 10:20 FENG, S. Y. Research Laboratory, University of Connecticut, Noank, Connecticut. Studies on a Bacterial Lysin in the Hemolymph of Crassostrea virginica.

10:20 - 10:40 BAKULA, MARION. Department of Biology, Saint Louis University, St. Louis, Missouri 63104. Isolation and Characterization of Antibacterial Proteins in Drosophila melanogaster.

10:40 - 10:50 PAULEY, GILBERT B. U. S. Department of Commerce, National Marine Fisheries Service, Biological Laboratory, Oxford, Maryland 21654. Characterization of an Agglutinin in the Hemolymph of the Blue Crab, Callinectes sapidus.

10:50 - 11:00 PAULEY, GILBERT B. U. S. Department of Commerce, National Marine Fisheries Service, Biological Laboratory, Oxford, Maryland 21654. Attempted Immunization of the Blue Crab, Callinectes sapidus.

11:00 - 12:00 DISCUSSION AND SUMMARY OF MORNING SESSION.

Wednesday Afternoon, August 30. SESSION 9, Elizabeth W. Davidson, presiding. Appleby Hall 350.

2:00 - 2:15 MINGS, G. W. and ROSSMOORE, H. W. Department of Biology, Wayne State University, Detroit, Michigan 48202. The Effect of Irradiation on Melanogenesis in Larvae of Hemerocampa leucostigma. (Abstract not submitted).

2:15 - 2:30 ROGERS, B. G. and ROSSMOORE, H. W. Department of Biology, Wayne State University, Detroit, Michigan 48202. Ultra-Structural Studies on Irradiated Larvae of Hemerocampa leucostigma. (Abstract not submitted).

2:30 - 2:45 DUCOFF, HOWARD S. and HOSKINS, TERESA L. Department of Physiology and Biophysics, University of Illinois, Urbana, Illinois 61801. X-Ray Response of Adult Tribolium brevicornis.

In Tribolium brevicornis, newly available as an experimental animal, individuals are of much larger size and slower larval development than in other Tribolium. Our preliminary data suggest exceptionally great adult longevity. Irradiated adults rarely die, even after 15000 R, during the 5-week observation period used for T. castaneum and T. confusum. This is misleading, however: Acute LD_{50} for young adult

T. brevicornis is below 6000 R, or about that of the most sensitive strains of T. confusum, but in T. brevicornis mortality begins only after 4 weeks and is complete only after 9 weeks. Unlike T. confusum and T. castaneum, T. brevicornis radiosensitivity does not increase with age-at-exposure. Clearly, though post-irradiation survival time is not a valid criterion of resistance, comparative studies with T. brevicornis offer an exciting new tool for probing contributions of metabolic rate and cell-turnover time in development of lethality after administration of radiation, toxic chemicals, or pathogens.

2:45 - 3:00 KUNO, GORO. Department of Biology, University of Puerto Rico, Mayaguez, Puerto Rico 00708. Biological Notes of Amoebidium parasiticum.

Several aspects of the biology of Amoebidium parasiticum were studied with Aedes aegypti as a major host. In the life cycle, variations in vegetative growth and lack of fusion between amoeboids were recognized. The fungus has a broad host spectrum, but a small degree of host specificity was observed. Contrary to the speculation in the past, hormones did not induce amoebogenesis. A heat-stable, dialyzable fraction of the homogenate of the mosquito larvae, however, increased the percentage of amoebogenesis. The fungus does not cause mortality among A. aegypti larvae under optimal rearing conditions for the host, but under starvation mortality of fungus-associated larvae increased significantly over that of controls.

3:00 - 3:15 SCHERRER, P., LÜTHY, P. and TRÜMPI, B. Institute of Microbiology, Swiss Federal Institute of Technology, Zürich, Switzerland. The Relationship Between Culture Conditions and Endotoxin Formation of Bacillus thuringiensis.

Bacillus thuringiensis var. thuringiensis was cultured in a defined medium with different concentration of glucose as carbon source. The size of the parasporal inclusions was closely related to the glucose concentrations; low levels yielded small crystals whereas big parasporal bodies were formed in media containing high glucose concentrations. The investigation of the relationship between oxygen supply and crystal formation showed that increased aeration of the culture medium led to the development of extremely small parasporal inclusions. This is thought to be due to the intensified metabolic activity of vegetative and sporulating cells under high aeration rates. Finally, the toxic activity of crystals produced under the various culture conditions was compared. Big crystals from media with high glucose levels were more toxic than crystals from media with low glucose concentrations. However, the small parasporal bodies formed under a surplus of oxygen were more toxic than crystals originating from cultures with low aeration rates.

3:15 - 3:25 LÜTHY, P. Institute of Microbiology, Swiss Federal Institute of Technology, Zürich, Switzerland. The Susceptibility of Bacillus thuringiensis to a Phage.

Phages represent a severe threat to the commercial production of Bacillus thuringiensis. Little is known about phages of B. thuringiensis and their relationship to the host. A strain of a phage was isolated from a commercial preparation of B. thuringiensis and a lysate was produced with the original host strain. About 30 strains of B. thuringiensis, with at least one representative of each serotype, were tested for susceptibility to this lysate. The phage showed lytic activity with approximately 60% of the strains of B. thuringiensis. The insecticidal activity of the B. thuringiensis strains was compared with the sensitivity against the phage. Most of the sensitive bacterial strains were highly toxic whereas phage resistant strains showed low toxic activity against the test insect, Pieris brassicae. The phage sensitivity of B. thuringiensis changed during the growth phases. The vegetative cells were very sensitive in the lag- and early log-phase but became increasingly resistant towards the end of the logarithmic growth phase.

3:25 - 3:45 RECESS.

3:45 - 4:00 SPLITTSTOESSER, C. M., TASHIRO, H., LIN, S. L. and FIORI, B. J. New York State Agricultural Experiment Station, Cornell University, Geneva, New York 14456. Histopathology of the European Chafer, Amphimallon majalis, Infected with Bacillus popilliae.

Third instar larvae of the European chafer were challenged orally or by injection with spore suspensions of Bacillus popilliae. Histological examinations were made of larvae sacrificed at various exposure times from 0 hours to 22 days in order to study the sequence of infection. Observations on spore germination, multiplication of vegetative cells and subsequent sporulation will be presented.

4:00 - 4:10 ST. JULIAN, GRANT, BULLA, LEE A., JR., and ADAMS, GORDON L. Northern Regional Research Laboratory, 1815 N. University, Peoria, Illinois 61604. Milky Disease Development in Field-Infected Japanese Beetle Larvae. (This is a laboratory of the Northern Marketing and Nutrition Research Division, Agricultural Research Service, U. S. Dept. of Agriculture.)

By correlated visual and microscopic examination, milky disease of field-infected third-instar Japanese beetle larvae is categorized into four phases. The phases are described as sequential disease symptoms I through IV. All four phases persist simultaneously throughout experimental incubation. Larvae die during all phases of the disease; however, the largest percentage of death is at phase II and III of the infectious process. At phase II, 90% of the total population of cell types in the infected hemolymph are vegetative cells; in phase III 65-76% are vegetative cells with 17-28% spores. The massive spore population (95% of population) that characterizes milky disease is designated phase IV; less than 30% of larvae reach this phase of the disease.

4:10 - 4:25 DAVIDSON, ELIZABETH W. Department of Entomology, 1735 Neil Ave., The Ohio State University, Columbus, Ohio 43210. Ultrastructure of the Pathogenesis of American Foulbrood Disease.

Using electron microscopy, the pathogenesis of American Foulbrood disease was followed from introduction of Bacillus larvae spores into susceptible honey bee (Apis mellifera) larvae to death of the host and sporulation of the pathogen. Interaction between bacterial vegetatives and the peritrophic membrane was investigated. Toxic or enzymatic bacterial action was not found during the initial interaction of parasite and host midgut cells. Phagocytosis was shown to be a mechanism for bacterial penetration of host cells. Bacterial spores, giant flagella, and variant forms were studied.

Wednesday Afternoon, August 30. SESSION 10, Immunology (continued). Appleby Hall 150.

2:00 - 2:20 PYE, ALBERT E. Department of Entomology, 1735 Neil Avenue, The Ohio State University, Columbus, Ohio 43210. Phenoloxidase in Two Strains of Galleria with Different Immune Responses.

2:20 - 2:40 SCHWEMMLER, WERNER. Arbeitsgruppe Prof. Gottschewski am MPI für Immunbiologie, 78 Freiburg, Stefan Meier Strasse 8, West Germany. Lysozyme in the Control Mechanisms of Endosymbiosis by Euscelis plebejus.

2:40 - 2:50 DISCUSSION.

2:50 - 3:10 RECESS.

3:10- 3:30 HARSHBARGER, JOHN. Registry of Tumors in Lower Animals, Museum of

Natural History, Smithsonian Institution, Washington, D. C. 20560. Report of Tumor Registry of The Smithsonian Institution.

3:30 - 3:50 WEISS, DAVID W. Department of Immunology, The Hebrew University, Hadassah Medical School, Jerusalem, Israel. Non-Specific Modulation of Immunological Responsiveness as a Crucial Aspect of Normal Immune Function.

3:50 - 4:00 DISCUSSION.

4:00 - 4:30 SUMMARY OF AFTERNOON SESSION.

4:30 - 5:00 SUMMARY OF SYMPOSIUM.

Thursday Morning, August 31. SESSION 11, Physiopathology, contributed papers. presiding officer to be appointed. Kolthoff S132.

9:00 - 9:15 NEWMAN, MARTIN W. and WARD, GEORGE E., JR. U. S. Dept. of Commerce, National Ocean and Atmospheric Admin., National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Oxford, Maryland 21654. Some Aspects of the Epizootiology of Gray Crab Disease in Chincoteague Bay, Virginia.

Several isolated investigations of Paramoeba perniciosa infections in blue crabs (Callinectes sapidus) have been made during the past five years. Most have only involved diagnosis of the disease in moribund crabs. In the spring of 1971 an attempt was made to elucidate some aspects of the epizootiology of the disease in an enzootic area. An epizootic occurred in Chincoteague, Va., during June. The maximum prevalence was at least 17%. Crabs appeared to succumb rapidly and the indications were that all animals attaining patent infections would eventually die. Paramoeba perniciosa is believed to be the probable cause of previously reported mass mortalities of blue crabs along the southeastern Atlantic coast.

9:15 - 9:30 LIGHTNER, D. V. U. S. Department of Commerce, NOAA, National Marine Fisheries Service, Biological Laboratory, 4700 Avenue U, Galveston, Texas 77550. Postmortem Change in the Brown Shrimp, Penaeus aztecus, Ives.

Before histopathological findings from disease conditions in shrimp can be evaluated, histological changes due to normal postmortem changes must be distinguished from alterations due to disease. In the present study juvenile brown shrimp were killed

by suffocation in air. Dead shrimp were held in either sea water (at a salinity of 50 ppt) or in water-saturated air at temperatures of 10, 20, and 30°C. Samples for gross and histological examination were taken from both groups at 0, 0.5, 1, 2, 4, 8, 12, 24, 48, and 72 hours after death of the shrimp. Grossly, the first change observed was the onset of a rigor-like condition of the abdomen which appeared at about 2 hrs. after death at 30°C and at 4 and 24 hrs. at 20 and 10°C, respectively. The abdomen became flaccid at 12 and 48 hrs. after death in shrimp held at 30 and 20°C, but at 10°C the abdomen remained rigid at 72 hrs. after death. Leakage of fluid material from the hepatopancreas and the appearance of spoilage odor began at 4 hrs. after death at 30°C and at 8 and 24 hrs. after death at 20 and 10°C. Histologically, the tubular epithelium of the hepatopancreas and the gut epithelium were the first tissues to show autolytic changes. Autolytic changes were later apparent in nerve ganglia, nerve fibers, antennary gland epithelium, gill epithelium, hypodermal epithelium, muscle, and connective tissue. In all tissues the rate of autolytic change was temperature dependent.

9:30 - 9:45 FONTAINE, C. T. and LIGHTNER, D. V. U. S. Department of Commerce, NOAA, National Marine Fisheries Service, Biological Laboratory, 4700 Avenue U, Galveston, Texas 77550. Observations on the Process of Wound Repair in Penaeid Shrimp.

The petersen disc tag is a standard mark for penaeid shrimp and attachment of the tag requires the insertion of a stainless steel pin through the shrimp's abdomen. This creates a relatively large puncture wound. The would healing process began at 24 hrs. following attachment of the tag with a pronounced leucocytic infiltration of the wound area. Leucocytes in contact with the pin became fusiform, began adhering to one another and formed several concentric layers around the pin. Scattered foci in the vicinity of the wound also attracted leucocytes, and these areas, possibly being either damaged tissue or bacteria, also became encapsulated by concentric layers of fusiform leucocytes. A dark brown pigment appeared in association with the innermost layers of leucocytes along the pin and at the foci. Leucocytic infiltration was followed by appearance of fibroblast cells and the deposition of a collagenous material along the wound channel (48 hrs. after wounding). Involution of the hypodermis and consequential exoskeletal involution into the wound channel began at 96 hrs. after wounding. Complete hypodermal and exoskeletal formation along the wound had occurred by 384 hrs. post-wounding.

9:45 - 10:05 DOMNAS, A., GIEBEL, P. and McINNIS, T., JR. Biochemistry Lab., Botany Department, University of North Carolina, Chapel Hill, No. Carolina 27514. Biochemical Changes in Culex quinquefasciatus var pipiens Larvae Following Infection with Lagenidium sp. Spores. (Fungus paper presented at meetings of Mycol. Soc. Amer.)

Lagenidium sp. is a fungus whose spores parasitize mosquito larvae of Culex quinquefasciatus var pipiens. Invasion nearly always begins in the head region and ultimately fills the entire organism resulting in 100% kill in approximately 40 hours in laboratory conditions. We have investigated various biochemical parameters of the infection process and have measured changes in carbohydrate levels, such as trehalose, maltose and glucose by gas chromatography. The ontogenic behavior of enzymes associated with carbohydrate metabolism such as chitobiase, trehalase, and phosphorylase have been studied. Changes in nitrogen metabolism have also been studied in normal and infected populations of Culex larvae. Changes in ammonia, total free amino acids, and protein have been measured as well as the behavior of enzymes such as tyrosinase, and glutamate-aspartate transaminase. All indications are that the larvae are dying due to acute physiological starvation and that other effects exerted are minimal.

10:05 - 10:25 HAREIN, PHILLIP K., DE LAS CASAS, ERNESTO and WRIGHT, VALERIE F. 226 Entomology, Fisheries, & Wildlife Building, University of Minnesota, St. Paul, Minnesota 55101. The Effect of Certain Mycotoxins on the Fertility and Fecundity of the Confused Flour Beetle.

Confused flour beetle adults were exposed to fifty fungal isolates known to produce mycotoxins. Based on adult mortality and number of progeny, the isolates were rated for further study. A method was devised for detection of the mycotoxin F-2 (zearalenone) from Fusarium roseum var. graminearum within the confused flour beetle. About 3 ppm was recovered after feeding these insects 2 weeks on rice flour containing 100 ppm F-2. Mixed metabolites of F. roseum, including F-2, were fed to confused flour beetles in rice flour. Egg production decreased and % hatch was lower than the controls. Pure extracted F-2 fed to confused flour beetles at 9,000 ppm in rice and corn meal increased the number of eggs and larvae, even after the adults were transferred to untreated meal. The % hatch was within the normal range of fertility for these insects. Similar experiments are in progress with F-2 and T-2 (trichothecene) from F. tricinctum in whole-wheat flour.

Thursday Afternoon, August 31. SESSION 12, Silver Anniversary Symposium, Marion A. Brooks, presiding, Science Classroom Bldg. 325.

2:00 - 2:25 VAGO, CONSTANT. Professor, Universite des Sciences et Techniques du Languedoc, Place Eugene Bataillon, 34 Montpellier, France. Aspects of the Development of Invertebrate Pathology.

2:25 - 2:50 COUCH, JOHN A. Environmental Protection Agency, Office of Research and Monitoring, Gulf Breeze Laboratory, Sabine Island, Gulf Breeze, Florida 32561. Estuarine and Marine Invertebrates as Indicators of Environmental Conditions.

2:50 - 3:15 CHENG, THOMAS C. Department of Pathobiology, Lehigh University, Bethlehem, Pennsylvania. Comparative Invertebrate Pathobiology as a Monitoring System for Environmental Pollution.

3:15 - 3:40 RECESS

3:40 - 4:05 BRIGGS, JOHN. Invertebrate Pathology Laboratory, The Ohio State University, Columbus, Ohio 43210. A Global Working System for Invertebrate Diseases.

4:05 - 4:30 KULOW, D. L. U. S. Department of the Interior, Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198. Remote Sensing Applied to Resource Problems.

4:30 - 5:00 TAYLOR, RONALD L. California State College, San Bernardino, Division of Natural Sciences, 5500 State College Parkway, San Bernardino, California 92407. Insects as Human Food.

ANNOUNCEMENT

FIFTH INTERNATIONAL COLLOQUIUM ON INSECT PATHOLOGY

SIXTH ANNUAL MEETING OF THE SOCIETY FOR INVERTEBRATE PATHOLOGY

Advance notice is given that these two events are to be run jointly at St. Catherine's College in Oxford, England, from 3 - 7 September, 1973. Although it will be only three years, instead of four, since the IVth International Colloquium, it was decided when Oxford was proposed as the venue for the Vth Colloquium, to combine this with the 1973 S.I.P. Annual Meeting which had already been planned to take place in Oxford. Further information will appear in future editions of the Newsletter.

RESULTS OF ELECTION

The following persons have been elected as officers of the Society:

President	J. D. Briggs
Vice President	A. M. Heimpel
Secretary	Marion A. Brooks
Treasurer	Y. Tanada
Trustees	M. C. Bergoin
	M. E. Martignoni

NEWS ITEMS

A. M. Tanabe has submitted his Ph.D. dissertation in the fall of 1971 at the University of California at Berkeley, California, U.S.A. The title of his thesis is: "The Pathology of a Microsporidia in the Armyworm, Pseudaletia unipuncta (Haworth) (Lepidoptera: Noctuidae)." He is presently working as an Assistant Research Entomologist at the Naval Biological Laboratory at the University of California.

John A. Couch obtained his Ph.D. degree in December 1971 at the Florida State

University. The title of his dissertation was: "Form, Morphogenesis, and Host-Ciliate Relationships of Lagenophrys callinectes (Ciliatea: Peritrichida)."

Researches in Invertebrate Pathology in Latin America and the Caribbean

by G. Kuno

The research activities in invertebrate pathology in Latin America and the Caribbean are relatively unknown to the majority of the members of S.I.P., except for those who maintain direct contact with Latin American investigators. I initiated an inquiry regarding such activities last year, and have so far obtained rather encouraging results. Although the survey is far from complete because of several reasons, I would like to present the readers an insight to some of the activities, so that those who find interests will be able to communicate with specific workers listed. (The addresses of the investigators appearing in parentheses are available in a mimeographed directory from my office upon request.)

Majority of the activities are related to the microbial control of insect pests in agriculture. Although corn, vegetables, tropical fruits, and others are also important, cotton is the major crop whose insect pests are the targets of intense microbial control in Central and a part of South America. This is true in Mexico (L. Alcocer; J. L. Carillo S.), Nicaragua (M. Vaughan R.) and Colombia (H. Alcaraz Vieco; A. Cujar; A. Saldarriaga). In the latter two countries, in particular, the cooperations with FAO and U.S.D.A., respectively, are noted. In Costa Rica (O. Hidalgo-Salvatierra), the uses of pathogens against cotton, corn, and forest pests are underway on an experimental basis. The study of fungal pathogens for forest pests has also been carried out in Colombia (A. E. Bustillo). In the Caribbean and part of South America, one of the major crops under investigation and/or of future consideration, in terms of microbial control of insect pests, is the sugar cane. This is the case in Brazil (M. Bezerra de Carvalho), Guadeloupe, French West Indies (P. F. Galichet; L. G. Gruner), Puerto Rico (G. Kuno), and Venezuela (J. Teran). Some Cercopids are apparently severe pests of the sugar cane in certain parts of Brazil (M. Bezerra de Carvalho) and Guyana (S. A. Apeji), and the suggestions as to the effective pathogens were solicited. Although apiculture has not been taken seriously by pathologists in these areas, several diseases of the honeybee have been studied in Venezuela (M. Stejskal).

The survey of the pathogens of medical insect pests has been conducted in Puerto Rico (G. Kuno); Gorgas Memorial Laboratory in Canal Zone (D. C. Baery) is reported to have collaborated with several North American and European investigators in finding diseased mosquitoes. A field experiment for the mosquito control with the use of a nematode has been recently initiated in El Salvador, with an assistance by U. S. Public Health Service.

A cytopathological study, involving a chromosomal aberration during the course of a nucleopolyhedrosis in Rhynchosciara fly, has been conducted in Brazil (A. B. da Cunha; C. Morsoletto).

G. Kuno, Department of Biology,
University of Puerto Rico,
Mayaguez, P. R. 00708

NEW MEMBERS

Dr. Robert S. Anderson, 494 Mayo, University of Minnesota, Minneapolis, Minnesota 55455.

Dr. Ionel Andriescu, Station de Recherches Biologiques et Géographiques, Lab. de Lutte Biologique, Pangarati - Neamt, Romania.

Kathleen Hsu Jeong, c/o G. W. Hooper Foundation, University of California, Medical Center, San Francisco, California 94122.

Dr. Lowell V. Larson, Abbott Laboratories, 14th & Sheridan, N. Chicago, Illinois 60062.

Dr. Hans E. Roman, Department of Microbiology, University of Umeå, Umeå 6, Sweden.

Dr. Claude Seureau, Lab. d'Histophysiologie des Insects, 12 Rue Cuvier, 75-Paris, V-ème, France

CHANGE OF ADDRESS

Dr. William M. Bode (Regular), Pennsylvania State University, Fruit Research Laboratory, Biglerville, Pennsylvania 17307.

Dr. Ronald C. Cowden (Charter), Department of Anatomy, Albany Medical College of Union University, Albany, New York.

Dr. Thomas A. Gochnauer (Charter), Entomology Section, Ottawa Research Station, Central Experimental Farm, Ottawa 6, Canada.

Dr. Clinton Y. Kawanishi (Regular), Department of Entomology, New York State Agricultural Experiment Station, Geneva, New York 14456.

Dr. Jorge K. L. Leong (Regular), Department of Microbiology, Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland 20014.

Madame Francoise Odier (Regular), Laboratoire Cytopathologie, 30-Saint-Christol-les-Ales, France.

Dr. Gilbert B. Pauley (Regular), U. S. Department of Commerce, National Marine Fisheries Service, Biological Lab., Oxford, Maryland 21654.

Dr. John A. Shadduck (Regular), 1925 Coffey Road, Columbus, Ohio 43210.

Dr. Kenneth M. Smith (Regular), 3 Sedley-Taylor Road, Cambridge, England.

Dr. Franklin Sogandares-Bernal (Founding), Department of Zoology, The University of Montana, Missoula, Montana 59801.

Susan Margaret Walker (Regular), 69 North Broadway, White Plains, New York 10605.