PROCEEDINGS
OF THE TWENTIETH ANNUAL
WESTERN FOREST INSECT WORK CONFERENCE

Coeur d'Alene, Idaho

March 10-13, 1969

<u>Not for Publication</u>

(For information of Conference Members only)

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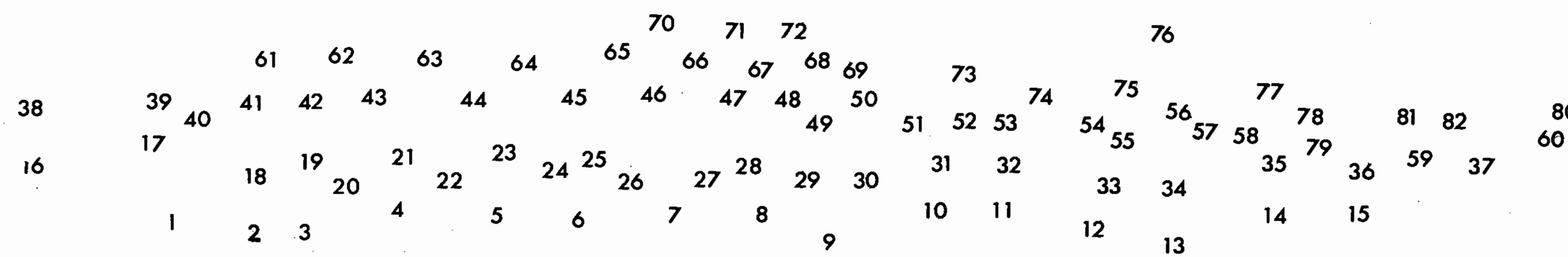
Forest Research Laboratory
Victoria, British Columbia


NORTH SHORE CONVENTION CENTER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1. Ralph Hall, 2. Walt Cole, 3. D.O. Van Denburg, 4. Don Schmiege, 5. Russ Mitchell, 6. Cal Massey, 7. LeRoy Kline, 8. Bob Stevens, 9. Mona Lambden, 10. Doug Parker, 11. Mark McGregor, 12. Wayne Bousefield, 13. Kazumi Kobayashi, 14. John Schmid, 15. Irwin Hall, 16. John Schenk, 17. Art Roe, 18. Cal SooHoo, 19. Noel Wygant, 20. Bob Thatcher, 21. Bob Gustafson, 22. Harold Flake, 23. Don Pierce, 24. Jim Mitchell, 25. Fred Honing, 26. Ken Lister, 27. Dave McComb, 28. Bob Fisher, 29. Gino Gasparotto, 30. Garry Boss, 31. Al Rivas, 32. Bill Ciesla, 33. Jed Dewey, 34. John Dale, 35. John Harris, 36. Tom Koerber, 37. Fred Dickison, 38. Joe Saunders, 39. Ken Graham, 40. Bob Stevenson, 41. Bill Wilford, 42. Gene Amman, 43. Harvey Toko, 44. Bob Harrison, 45. Galen Trostle, 46. Max Ollieu, 47. Lewis Edson, 48. Lloyd Browne, 49. Hank Thompson, 50. Pat Shea, 51. Gerry Lanier, 52. Don Dahlsten, 53. Art Heimpel, 54. Ross Macdonald, 55. Bernard Scott, 56. John Chapman, 57. Merle Richmond, 58. Alan Cameron, 59. Rick Johnsey, 60. Ron Stark, 61. Jack Coster, 62. Dick Mason, 63. Bill Klein, 64. Marcus Wells, 65. Don Curtis, 66. Joe Ball, 67. Bruce Roettgering, 68. Jim Wilson, 69. Bill Butt, 70. Ladd Livingston, 71. Rob Reid, 72. M. Ashraf, 73. Henry Moeck, 74. Norm Alexander, 75. Dave Wood, 76. Scott Tunnock, 77. Charlie Tiernan, 78. Don Bright, 79. Bob Dolph, 80. Dave Fellin, 81. Mel McKnight, 82. Tor Torgerson.

Row 1 (L. to R.) Al Hedlin, Clair Farris, Dick Hunt, Boyd Thomas, Donn Cahill, Herb Cerezke, Les Safranyik, H.T. Huang, Bohdan Maksymiuk, Royce Cox.

Row 2 (L. to R.) George Starr, Les McMullen, Dick Washburn, Barbara Barr, Bruce Baker, John Simeone, Hec Richmond, John Hard, Bill McCambridge, Roy Beckwith, Dave Crosby.

Row 3 (L. to R.) Murray Neilson, Don Renlund, Bob Lyon, Jim Richerson, M. Ashraf, Mal Furniss, C.J. DeMars, Sergei Condrashoff, Bill Bedard, Charlie Sartwell, Gene Paul, Dave Dyer, Karel Stoszek.

PROCEEDINGS
of the Twentieth Annual
WESTERN FOREST INSECT WORK CONFERENCE
Coeur d'Alene, Idaho
March 10-13, 1969

EXECUTIVE COMMITTEE (Twentieth Conference)

E. D. A. Dyer, Victoria	Chairman
R. I. Washburn, Moscow	Immediate Past Chairman
L. H. McMullen, Victoria	Secretary-Treasurer
R. E. Stevenson, Calgary	Councillor (1966)
J. F. Chansler, Denver	Councillor (1967)
P. G. Lauterbach, Tacoma	Councillor (1968)

R. I. Washburn, Moscow — Program Chairman

EXECUTIVE COMMITTEE ELECT

E. D. A. Dyer, Victoria	Chairman
R. I. Washburn, Moscow	Immediate Past Chairman
L. H. McMullen, Victoria	Secretary-Treasurer
R. E. Stevens, Fort Collins	Councillor (1967)
P. G. Lauterbach, Tacoma	Councillor (1968)
D. L. Dahlsten, Berkeley	Councillor (1969)

R. L. Johnsey, Olympia — Program Chairman

Prepared by the Secretary-Treasurer, L. H. McMullen, from summaries submitted by panel moderators and workshop leaders. Stenographic and duplication processing provided by the Forest Research Laboratory, Canada Department of Forestry, Victoria, B. C.

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TWENTIETH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

March 10-13, 1969

The Conference was convened at 9:00 a.m. on March 10, 1969, by Chairman Dave Dyer with the welcoming addresses.

MINUTES OF THE INITIAL BUSINESS MEETING

March 10, 1969

The meeting was called to order by Chairman Dyer at 10:30 a.m. in the Convention Center of the North Shore Motor Inn, Coeur d'Alene, Idaho with 157 registered members. A moment of silence in memory of Dr. H.C. Manis and Dr. George Allen was observed.

Recognition was given to Noel Wygant, George Struble, Jim Beal and W. L. Baker who have retired during the past year.

The Chairman introduced Mr. Kazumi Kobayashi from Japan who is visiting the Victoria Lab. for a year.

New members were then asked to rise and introduce themselves.

The Chairman appointed the nominating committee: Phil Johnson, Chairman, Rob Reid and Al Berryman, and charged them to nominate members to replace John Chansler for the remainder of his Councillor's term, one year, and to replace Bob Stevenson whose term expires at the end of this meeting.

Treasurer's Report was then read. Acceptance as read moved by Bill McCambridge and seconded by John Schenk. Carried.

Minutes of the final business meeting for 1968 were read and approved upon motion by Bob Stevens; seconded by Bill McCambridge. Carried.

Minutes of the executive committee meeting, March 9, 1969, were read leading to discussion on the following points:

A. Mailing list for notices. The members were asked to consider the discussion and be prepared to decide on procedure at the final business meeting.

B. Meeting places for 1970 and 1971. Invitations were received from Rick Johnsey for 1970 in Seattle and from Bob Stevenson for 1971 in Edmonton and Bob Stevens for Fort Collins area in 1971 or 1972.

The Chairman then asked Dick Washburn to discuss the arrangements and program for the current conference.

LeRoy Williamson brought to our attention the initiation of the Southern Forest Insect Work Conference, the first meeting to be held August 12 and 13. LeRoy is program chairman.

The Chairman adjourned the meeting at 11:30.

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PROGRAM

20TH WESTERN FOREST INSECT WORK CONFERENCE
Coeur d'Alene, Idaho, March 10-13, 1969

<u>Sunday, March 9</u>

7:00 - 8:00 p.m.	Registration for early arrivals, North Shore Lobby
8:00 - 10:00 p.m.	Meeting of Executive Committee, Suite 352

<u>Monday, March 10</u>

8:00 - 9:00 a.m.	Registration, Convention Center Lobby
9:00 - 10:00 a.m.	Welcome Mr. Larry Gardiner, Mayor of Coeur d'Alene Mr. Chandler St. John, Supervisor, Coeur d'Alene National Forest
10:00 - 10:30 a.m.	Coffee Break
10:30 - 11:30 a.m.	Initial business meeting
11:30 - 1:00 p.m.	Lunch
1:00 - 2:00 p.m.	Address: THE WHITE PINE COUNTRY AND ITS PEST PROBLEMS R. T. Bingham, Director's Representative, Intermountain Forest & Range Expt. Sta.
2:00 - 2:45 p.m.	Report: INTERNATIONAL CONGRESS OF ENTOMOLOGY Bob Stevens, Forestry Sciences Lab., Ft. Collins, Colo.
2:45 - 3:15 p.m.	Coffee Break
3:15 - 5:00 p.m.	Concurrent workshops:

1. <u>Chemical fertilizers as regulators of insect populations</u>.
   Dave G. Fellin, Forestry Sciences Lab., Missoula, Mont.
2. <u>Aerial surveys--new techniques</u>
   Jerry A.E. Knopf, Forest Pest Control, Boise, Ida.
3. <u>Effects of cacodyllic acid and other herbicides on forest insects</u>.
   Gary B. Pitman, Boyce Thompson Institute, Grass Valley, Calif.
4. <u>Bark beetle population dynamics</u>.
   Al A. Berryman, Washington State University.
5. <u>Cone and seed insects</u>.
   Al F. Hedlin, Forest Research Lab., Victoria, B.C.

Tuesday, March 11

8:30 - 9:45 a.m. Panel: ARTIFICIAL DIETS--PANACEA OR HEADACHE?
Moderator: Walter E. Cole, Intermountain Forest & Range Exp. Sta., Ogden, Utah.

Robert L. Lyon, Forestry Sciences Lab., Berkeley.
Kenneth Graham, University of British Columbia.
Lloyd E. Brown, University of California.

9:45 - 10:15 a.m. Coffee Break

10:15 - 11:30 a.m. Panel: MICROBIAL CONTROL OF FOREST INSECTS--PAST, PRESENT, FUTURE
Moderator: Bohdan Maksymiuk, Forestry Science Lab., Corvallis, Ore.

Art M. Heimpel, Insect Path. Pioneering Lab., ARS, Beltsville, Md.
H. T. Huang, International Minerals & Chemical Corp., Libertyville, Ill.
Irvin M. Hall, University of California
Toni Jasumback, Equipment Development Center, U.S. Forest Service, Missoula, Mont.
Ben Howard, U.S. Forest Service, Portland, Ore.

11:30 - 1:00 p.m. Luncheon. Guest Speaker: Jim Evenden
"THOSE WERE THE DAYS"

1:00 - 2:45 p.m. Concurrent workshops:

1. Progress in the use of pathogens to control forest insects.
   Hank Thompson, Forestry Sciences Lab., Corvallis, Ore.
2. Defoliator rearing.
   Cal Soo Hoo, Washington State University
3. Survey population sampling.
   Bob Stevenson, Forest Research Lab., Calgary, Albt.
4. Bark beetle rearing.
   Dick Schmitz, Forestry Sciences Lab., Moscow, Ida.
5. Mammalian and avian predators.
   Don Dahlsten, University of California.
6. Host selection and population survival.
   Rob Reid, Forest Research Lab., Calgary, Albt.

2:45 - 3:15 p.m. Coffee Break

Tuesday, March 11 (Continued)

3:15 - 5:00 p.m. Concurrent workshops:

1. Predator-parasite introduction, propagation, and release.
   Don Schmiege, Northern Forest Expt. Sta., Juneau, Alaska.
2. Research program formulation.
   Bob Thatcher, Forest Protection Research, Washington, D.C.
3. Mechanics of control operations.
   Galen Trostle, Forest Pest Control, Ogden, Utah.
4. Manipulation and aggregation behavior of bark beetles.
   Peter Vite, Boyce Thompson Institute, Beaumont, Texas.
5. Nematodes in forest insects.
   Cal Massey, Forestry Sciences Lab., Albuquerque, N.M.
6. Stand density and insect outbreaks.
   C. J. DeMars, Forestry Sciences Lab., Berkeley, Calif.

8:00 p.m. Color slide showing

Wednesday, March 12

8:30 - 9:45 a.m. Panel: PHEROMONES--READY OR NOT
Moderator: Gary B. Pitman, Boyce Thompson Institute, Grass Valley, Calif.

Dave L. Wood, University of California.
Billy A. Butt, Agric. Research Service, Yakima, Wash.

9:45 - 10:15 a.m. Coffee Break

10:15 - 11:30 a.m. Panel: ENVIRONMENTAL POLLUTION
Moderator: Philip C. Johnson, Forestry Sciences Lab., Missoula, Mont.

Fred W. Rabe, University of Idaho.
Robert F. Tarrant, Forestry Sciences Lab., Corvallis, Ore.

11:30 - 1:00 p.m. Lunch

1:00 - 5:00 p.m. Tour of Coeur d'Alene Area

8:00 p.m. Banquet

Thursday, March 13

8:30 - 9:00 a.m. Report: INFORMAL DISCUSSION OF WESTERN FOREST INSECT MANUAL—Bob Furniss

9:00 - 10:00 a.m. Concurrent workshops:

1. Insect fungus relationships.
   John Chapman, Forest Research Lab., Victoria, B.C.
2. Insects of deciduous trees and shrubs.
   Sergei Condrashoff, Forest Research Lab., Victoria, B.C.
3. Environmental pollution and regulation of insect population.
   Ron Stark, University of California.
4. Pheromones and attractants.
   Bill Bedard, Forestry Sciences Lab., Berkeley, Calif.
5. Environmental entrainment of insect activity.
   Joe Saunders, Western Washington Research Expt. Center, Puyallup, Wash.
6. Insect photography.
   Wally Guy, Pacific Northwest Forest & Range Expt. Sta., Portland, Ore.

10:00 - 10:30 a.m. Coffee Break

10:30 - 11:30 a.m. Continuation of above workshops.

11:30 - 1:00 p.m. Lunch

1:00 - 2:30 p.m. Final business meeting

2:30 - 3:00 p.m. Coffee Break

3:00 - 5:00 p.m. SUMMATION AND CRITIQUE (a discussion)
Moderator: Al Rivas, Forest Pest Control, Ogden, Utah.

Bill F. McCambridge, Forestry Sciences Lab., Fort Collins, Colo.
Jim H. Lowe, University of Montana.
Ken Graham, University of British Columbia.

THE WHITE PINE COUNTRY AND ITS PEST PROBLEMS

by Richard T. Bingham

Summary

The mountainous country in northern Idaho, northeastern Washington, and western Montana is the most productive of all forest land in the Rocky Mountain Belt. The white pine country embraces about 5 million acres. The bountiful rainfall plus favorable temperature for growth produce relatively high growth rates. White pine grows as a seral species in a number of habitat types, having a rather wide ecological amplitude. It tends to grow at intermediate elevations and climatic conditions.

Forests of the white pine country are made up of a number of species varying from rather pure forests of a single species to forests of a great mixture of species. Going from species occupying warm and dry sites to those found on cold and wet sites, the species are ponderosa pine, Douglas-fir, western larch, lodgepole pine, grand fir, western white pine, western redcedar, western hemlock, Engelmann spruce, subalpine fir, mountain hemlock and whitebark pine. These species vary in tolerance from intolerant to tolerant about as follows:

1. Western larch
2. Lodgepole pine
3. Ponderosa pine
4. Douglas-fir
5. Western white pine
6. Grand fir
7. Engelmann spruce
8. Whitebark pine
9. Subalpine fir
10. Western hemlock
11. Mountain hemlock
12. Western redcedar

Associated with their intolerance, western larch, lodgepole pine, and ponderosa pine have very rapid initial growth rates. Douglas-fir, grand fir, western white pine, and Engelmann spruce have intermediate initial growth rates, and the tolerant species have slow initial growth rates.

Over the centuries, fire has been the single most important upset factor in white pine forests. It has repeatedly burned over virtually every acre of the country. It has kept the intolerant seral species including western white pine as components of these forests.

The mountain pine beetle has probably been the second most important factor affecting these forests over the years. However, a number of other insects, diseases, and climatic factors such as wind have had a large part in shaping the character of the forests.

Since the advent of white man, his activities, including the indiscriminate use of fire, cutting, and introduction of pests, has had a

tremendous effect on white pine forests. Man began to affect these forests in an appreciable way from about 1860. His first influences were through the indiscriminate use of fire in mining, railroad construction, hunting, logging, and road building. Logging on a substantial scale did not occur until after 1900. Until World War II, the only species of commercial importance were western white pine, ponderosa pine, western redcedar in the form of poles, and some western larch and Douglas-fir as construction timber. The others were noncommercial. Beginning about World War II all species came into use.

The ecology of white pine forests and silvicultural methods to favor western white pine had been pretty well worked out by World War II. Any of the even-aged silvicultural systems including seed tree, shelterwood, and clear-cut systems could be applied in appropriate situations. Selection systems favored the tolerant species at the expense of the more valuable western white pine. Paradoxically, most cuttings before World War II in white pine forests resulted in selection cutting because so much of the stand was unmerchantable.

Today pests such as white pine blister rust and the larch casebearer are requiring a major change in the management planning of these forests. Major pests for each species are:

1. Western white pine
    a. White pine blister rust.
    b. Mountain pine beetle
    c. Pole blight
    d. Root rots
    e. Heart rots

2. Western larch
    a. Larch casebearer
    b. Dwarfmistletoe
    c. Needle blight

3. Douglas-fir
    a. Douglas-fir beetle
    b. Spruce budworm
    c. Root rots
    d. Dwarfmistletoe

4. Grand fir
    a. Heart rot - Echinodontium
    b. Spruce budworm
    c. Threat of balsam woolly aphid

5. Engelmann spruce
    a. Engelmann spruce beetle
    b. Spruce budworm

6. Subalpine fir
    a. Heart rots
    b. Spruce budworm
    c. Root rots

7. Western hemlock
    a. Heart rot

8. Western redcedar
    a. Heart rots
    b. Root rots

9. Lodgepole pine
    a. Mountain pine beetle
    b. Root rots - short life in white pine country

10. Ponderosa pine
    a. Dwarfmistletoes
    b. Western pine beetle
    c. Pine engraver
    d. Mountain pine beetle

11. Mountain hemlock
    a. Heart rots

The significance of pest problems in the white pine country can be summarized by four statements.

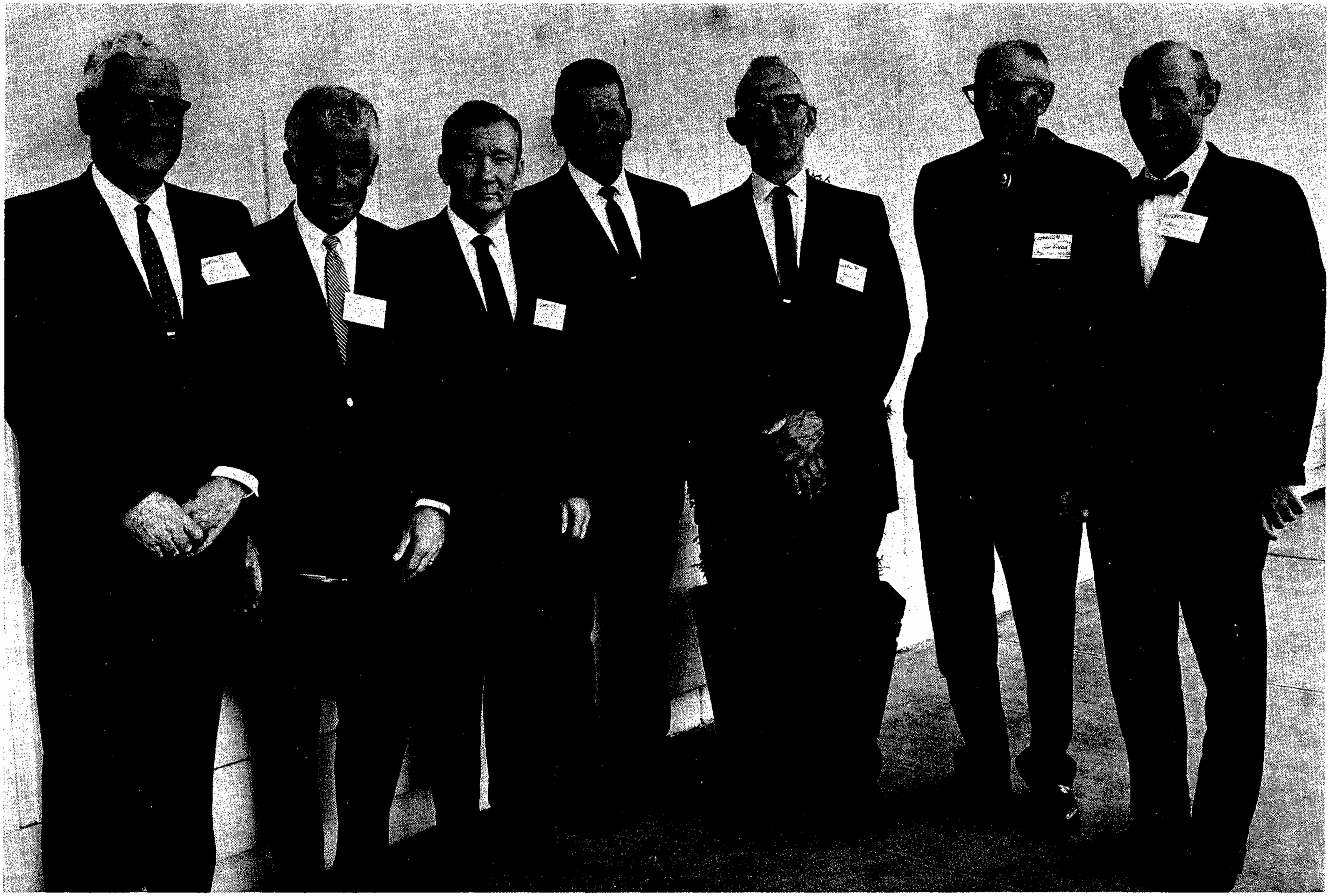
A. They vitally affect the management of forests of the white pine country.

B. Each tree species has pest problems that must be solved. We cannot afford to give up any species.

C. At a time when timber famine has finally become a reality, the control of forest pests is critical to obtaining full site production, and to the increase in timber supplies.

D. Forest protection is a vital part of forest management and must be integrated into all management practices.

The entomologist has an extremely important role to play in solving problems of forests of the white pine country. Three insect problems of major importance are the larch casebearer, the mountain pine beetle, and the spruce budworm. Solution of these urgent pest problems is especially critical at this time.



Luncheon Guest Speaker: Jim Evenden

Jim Evenden gave a lively address on the days of the forest insect laboratory at Coeur d'Alene, Idaho entitled "Those were the days". The history of that laboratory is pretty much that of James C. Evenden who was the administrator for all but one month of its 35-year existence. In the picture opposite are Jim and his staff at the time of his retirement on December 31, 1954. They are, left to right, Phil Johnson, Dave Fellin, Dave McComb, Bob Denton, Jim Evenden, Tom Terrell, Galen Trostle. Missing is Archie Gibson, now retired and living in Missouri.

It might be said that the Coeur d'Alene Forest Insect Laboratory had its beginning on June 12, 1919 when Jim Evenden returned from military duty in World War I. At that time, he was asked by Dr. A. D. Hopkins, Chief, Division of Forest Insect Investigations, Washington, D. C., to establish a forest insect laboratory in the northern Rocky Mountains at a location of Jim's choosing. Jim chose Coeur d'Alene.

The first laboratory was housed in a residence on South Seventh Street in town, where it remained until the early 1920's. It was moved into the Federal Building upon completion of that edifice. The laboratory was housed in the Federal Building until the end of January 1955.

During all of its years at Coeur d'Alene, the laboratory was almost the sole source of information on forest insect problems in the northern Rockies. Its chief functions were (1) research on the biology, ecology, and control of forest insect pests, (2) surveys to detect and evaluate outbreaks of economically important forest insects, and (3) advice on the biological aspects of controlling outbreaks of forest insect pests.

Until the 1930's when the forest insect laboratory at Fort Collins, Colorado was established, the Coeur d'Alene laboratory exercised these functions throughout all the Rocky Mountain states. Geographic responsibility for these functions further declined in 1950 when a similar laboratory was opened at Ogden, Utah. From 1950 until the laboratory was moved to Missoula, the Coeur d'Alene laboratory carried out its functions in northeastern Washington, northern Idaho, Montana, northwestern South Dakota, and that part of Wyoming inside of Yellowstone National Park.

The Coeur d'Alene Forest insect laboratory was always a field operation of the U. S. Department of Agriculture. It was administered from the Washington office of the Department's Bureau of Entomology (1919-1934) or Bureau of Entomology and Plant Quarantine (1934-1953), and by the Division of Forest Insect Investigations of these two bureaus. In November 1953, a Departmental reorganization placed forest investigations in the Forest Service. In that year the Coeur d'Alene Forest Insect Laboratory became the Coeur d'Alene Research Center of the Intermountain

Forest and Range Experiment Station with headquarters in Ogden.

In November 1953, Jim Evenden assumed the dual role of leadership of the Coeur d'Alene Research Center and Chief, Division of Forest Insect Research for the Intermountain Station. He remained in this role with headquarters in Coeur d'Alene until he retired December 31, 1954.

On February 1, 1955 the Coeur d'Alene Research Center was moved to Missoula, Montana where it became the Missoula Forest Insect Laboratory of the Intermountain Station under the leadership of Philip C. Johnson.

Many forest entomologists of reknown were assigned to the Coeur d'Alene Forest Insect Laboratory during its earlier years. These included R. E. "Reg" Balch, Charles Delles Bedard, Donald DeLeon, Max England, Archie L. Gibson, Roy Nagle, Henry Rust, and Tom T. Terrell. In later years these pioneer entomologists were joined by the contemporary work of Robert E. Denton, Philip C. Johnson, David McComb, Galen C. Trostle and many summer student assistants some of whom have since established permanent careers in forestry and forest pest control.

The Coeur d'Alene laboratory made significant contributions to forest entomology. Its researchers provided most of what is known of the mountain pine beetle in the extensive western white pine forests of Idaho. Despite great distances, rough topography and limited roads, it kept abreast of disastrous and small but academically interesting insect outbreaks alike. And it gave foresters the know-how to cope with applied control measures for countless outbreaks of a gamut of destructive forest insects. It was the undisputed source of help when insects threatened in the forests of the northern Rockies. Help, and good help, was always forthcoming from the laboratory at Coeur d'Alene.

Jim Evenden saw to that.

Philip C. Johnson

PANEL: ARTIFICIAL DIET—PANACEA OR HEADACHE

Moderator: W. E. Cole

Participants: Lloyd E. Browne, Kenneth Graham, Robert L. Lyon, Gino Gasparotto.

Why diets? Is an "artificial diet" a real necessity? Considering the inevitable effects of diet on the insects then truly the development of a diet to its final usable form is a headache. We must consider effects over more than one generation and such consequences as reflected by:

- behavioral aspects
- genetic quality
- the ability to compare laboratory results against field results—particularly in population studies, and
- the overriding physiological effects.

Before undertaking the discussion on diet we must qualify the use or purpose for which the diet is being considered. In other words, one diet may be quite acceptable when used to grow field collected insects to a certain stage, but unacceptable if one desires many generations as involved in behavioral or population experiments.

The following definitions are in order to maintain continuity of discussion:

- Holidic diet is one of which the chemical structure and purity of all constituents are known
- Meridic diet is one which contains a holidic base, but one constituent of unknown chemical structure and purity is added, e.g. casein
- Oligidic diet is one in which the main constituents are crude organic material, e.g. phloem-base diets.

Most, if not all of the following remarks are concerned with meridic diets. The meridic diet has the advantages of:

1. being less expensive
2. facilitates mass rearing
3. requires less space
4. not being dependent upon a natural food source
5. being able to avoid pathogens
6. abiding by quarantine regulation
7. ability to respond quickly to research demands.

Problems involved with meridic diet rearings center around:

1. the need for extreme sanitation measures

2. the presentation of the diet to the insect
3. environmental conditions of the laboratory or rearing cages
4. the physical effects upon the insect

When rearing using a meridic diet is done for a specific purpose such as pheromone production one must simulate closely natural conditions. Pheromones are highly influenced by the chemical constituents of the food - natural or artificial. The feeding stimulus is highly important. Actually a synergistic action exists between the beetle and the host material. Therefore the use of natural host material in the diet is almost mandatory.

Within other insect species such problems as loss of host preference, encouragement of virus, loss of ability to enter diapause and the possibility of destroying beneficial biotics have continually arisen. Thus qualitative changes occur which can and do disrupt comparisons of experiment results between lab and field.

In order to properly evaluate any diet one of the primary requisites is to begin with a disease-free population. A set of criteria for evaluation could well be:

1. Larval weight--modify diet, weigh larva and determine the relationship
2. Percent pupation--or prepupation at a given time, normally using several consecutive days
3. Item 2 is true also for larval development time
4. Fecundity - quantitative comparisons are good as well as hatching time

Finally, evaluation of any diet must depend upon a wide or random selection of the individuals to be used in order to place possible genetic influence in a random position.

The last point of the discussion brought out the behavioral aspects as influenced by diet. The behavioral pattern can be divided into 2 phases:

1. Reproduction
2. Developmental

The reproductive phase is concerned with behavior during the pre- and current period of mating--feeding prior to oviposition, diapause, the maturation period.

The developmental phase or development of the egg is closely related or dependent upon the pre-oviposition history.

The stimulus-response involved in kinesis and other behavioral aspects must be understood and utilized before any success of diet produced insect populations is obtained.

In summary, an intimate knowledge of the behavioral, feeding, physical and nutritional requirements is mandatory for success.

PANEL: MICROBIAL CONTROL OF FOREST INSECTS--PAST, PRESENT AND FUTURE

Moderator: Bohdan Maksymiuk

Participants: Art M. Heimpel, H.T. Huang, Irvin M. Hall, Tony Jasumback, Benton Howard.

Recorder: R.E. Stevens

The panel moderator in developing a theme for discussion emphasized that despite the fact that microbial control of forest insects is safe and does not pollute the environment, it is a slowly developing child on the unsufficient diet of science, technology, and practice. Interdisciplinary approach and interaction of different points of view are necessary to develop rational and effective control methods. Dr. Maksymiuk pointed out that the panelists represent a wide spectrum of experience and interest and come from different government agencies, universities, and industry. He emphasized that strength in developing microbial controls lies in diversity--different points of views.

1. Researcher's Point of View.

Dr. Art M. Heimpel, as leadoff panelist, reviewed past attempts of using microbial insecticides to control insect pests and analyzed successes and failures. Many field trials produced variable results. This was frequently attributed to variable (not standardized) preparations and methods of application. In general, viruses produced more reliable results than other entomogenous pathogens.

Successful commercial production of Bacillus thuringiensis and approval of its use by the Food and Drug Administration resulted in the first real breakthrough in practical microbial control. Cooperation of industry will be needed to produce various preparations for field testing. There is a growing need to increase the exchange of information and improve coordination of research efforts to accelerate progress in the microbial control of forest insects.

Research is being conducted on insect diseases caused by bacteria, viruses, fungi, protozoa, and rickettsiae. At the present time, bacteria and viruses offer the greatest potential for field use.

2. Pathogen Producer's Point of View

Dr. H.T. Huang pointed out that the potential producer faces three major questions when he begins to consider the commercial development of microbial insecticides: (1) what microbial pathogens are available, (2) how can they be produced, and (3) what data are needed to register a commercial product with the Federal Government?

In terms of production technology, two methods are already operational. First, use of whole organisms; the host insect is reared and infected with the appropriate agent, and the diseased larvae are collected and processed to obtain a crude product. Examples are Bacillus popilliae and a number of nuclear polyhedrosis viruses of several insects.

The second method is fermentation. It has been used successfully for the commercial production of Bacillus thuringiensis. This method is generally applicable to produce bacteria and fungi.

The third technology may become important in the future. It is the use of tissue culture techniques including organs, tissues, and dispersed cells. This is common procedure for production of most animal virus vaccines. However, insect tissue culture technology is still in a very rudimentary stage.

After developing a procedure for large-scale production and suitable formulation, the final hurdle would be to obtain approval and a registration from the Federal Government (USDA and FDA) to sell the product. This requires demonstration of field efficacy and evidence of safety. The safety data are established by a series of tests including toxicity, pathogenecity, allergenecity, carcinogenecity, and teratogenecity. Current estimates are that the safety tests alone would cost about $250,000. The total development cost for a microbial insecticide from laboratory inception to commercial production is at least $1.8 million.

3. Educator's Point of View

Dr. Irvin M. Hall discussed the needs and possibilities for training microbial control specialists capable of taking research information and applying it effectively in pest control under various forest situations. Graduate instruction in insect pathology is given at a number of universities in the United States. However, despite the great need, none of these schools offer a program for training microbial control specialists. Since microbial control is of applied nature it is not considered to be in keeping with the guidelines for higher education established by these institutions.

Instruction in insect pathology--microbial control for the multidisciplinary forest researcher should minimize the theoretical and basic phases of insect pathology, and emphasize the applied microbial control aspects. It should prepare the forest entomologist to recognize diseases and their causal agents and know how to use them in the control of forest insect pests. Such training could be offered at any institution where insect pathology is now part of the curriculum. It could be handled best if it is given in conjunction with training in forest entomology in a school where great emphasis is given to solving applied problems. With enough interest and demand, it is probable that this training could be set up as either a formal offering or a short course, with or without credit, under the auspices of university extension.

4. <u>Engineer's Point of View</u>

Tony Jasumback emphasized the need of suitable spray equipment for efficient application of microbial insecticides. Aerodynamics of aircraft must be considered for design, satisfactory performance, and safe mounting of spray equipment.

A series of helicopter spray tests were conducted cooperatively by the Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory in Corvallis, Ore., and Agricultural Research Service, Agricultural Engineering Research Division, Forest Grove, Ore., to develop an operational method for the control of the Douglas-fir tussock moth by aerial application of polyhedrosis virus. From these tests, specifications were finalized for design and fabrication of quick-attachable helicopter spray equipment, spray mixing, and loading equipment.

Some equipment requirements for application of microbial insecticides are as follows:

A. Spray equipment should be quickly attachable on commonly used helicopters.

B. The pathogens are most frequently applied in the water-base spray formulations as suspensions. Since pathogens are heavier than the carriers, they settle. Therefore, spray equipment should provide agitation of spray formulation to insure uniform concentration of pathogens. This is essential for uniform application.

C. Pathogens are living organisms. They must not be harmed in spray equipment by high temperature and mechanical forces; this particularly applies to the spray pump.

D. Spray equipment must be corrosion free, suitable for chemical sterilization using corrosive agents, for example, chlorox.

E. Equipment must be flexible to deliver different application rates and spray atomizations and prevent trapping pathogens in the spray system.

Based on study plans describing requirements and specifications prepared by the Forestry Sciences Laboratory in Corvallis, a cooperative agreement was made with the U.S. Forest Service Equipment Development Center in Missoula, Mont., to design and fabricate spray equipment. Spray mixing and loading equipment and a quick attachable helicopter spray system has been manufactured and delivered to Corvallis. This spray equipment is especially suitable for application of medium and high volumes of microbial insecticides. It provides continuous recirculation of spray in the whole system. This results in uniform distribution of pathogens and other additives that are heavier than the formulation.

Another quick attachable helicopter spray system for ultra-low volume application is nearly completed. This system will provide for changing application rates in flight and continuous agitation of spray. Part of this system is a smoke generator mountable on the spray helicopter. It will be used to determine favorable meteorological conditions for aerial application of insecticides.

Dr. Maksymiuk introduced Peter A. Boving, agricultural engineer, and Robert G. Winterfeld, pilot, both from ARS, Forest Grove, Ore. He acknowledged their cooperation in equipment development and field studies.

5. <u>Pest Controller's Point of View</u>

Benton Howard was the wrap-up panelist. His presentation for discussion is given in its entirety.

Let's look at the title, "Microbial Control of Forest Insects—Past, Present, and Future." In western United States, we essentially have had no past, the present is pretty shaky, but the future is exciting.

As of now nearly all, if not all, microbial control in forest use in the West has been essentially "tests," has been done with too little knowledge, probably imperfect materials, and too late biologically speaking. And all has been done rather prayerfully. Few if any of these tests were susceptible of adequate evaluation. Where the population declined, it has been difficult to tell whether it was due to natural causes or to the application of the material.

The other panel members are scientists and specialists, I am not. I am a pest control administrator and a generalist. Let's look at their place in the scheme of things. Dr. Heimpel, research—the researcher provides the facts and much of the knowledge that is necessary to achieve results. Dr. Huang, producer--it is his responsibility to produce uniform materials batch after batch, year to year, otherwise we are severely handicapped. Dr. Hall, speaking for the educator--here is where the philosophy, the approaches are developed, and here is where the men who provide the skills start in and become knowledgeable. Tony Jasumback, the engineer--he is the man that develops the equipment, provides the hardware. Certainly in light of our endeavors in space, the hardware is extremely critical. These are the disciplines that make it possible for me to consider, and I stress the word consider, the use of microbial control.

There are other means of control, of course, that must be examined at the same time. Chemicals, silvicultural control, parasites, and predators--these have to be thought about along with microbial control. How does each one fit in its place? Which combination of these would serve best in any particular instance; and furthermore, let us not forget that above all we have the option of doing nothing. But to paraphrase Mr. Truman, "The buck stops with me (the Pest Control Administrator), and the decision must be made."

In making this decision, don't forget the political problems: increasing criticism, particularly as relates to chemical pollution of the environment puts a great handicap on the use of what could and should be a real valid and acceptable means of controlling insect epidemics. But let us not forget that the use of microbials, bacterium, virus, or what have you will have an emotional impact on segments of the public and that will have to be considered as we move to their use.

The Dictionary man says--

A. Microbe - a very minute living thing, whether plant or animal; microorganism; especially any of the bacterium that cause disease; germ.

B. Bacteria - typically one-celled microorganisms; some bacteria cause disease such as pneumonia, tuberculosis and syphilis....

C. Virus - (L.) a slimy liquid, poison, 1. venom as of a snake, 2. any of a group of ultra microscopic or submicroscopic infective agents that cause various diseases such as smallpox....

Isn't this horrible!!

I can see some of the headlines in papers and some of the comments from our more emotional people: "Forest Service is spreading disease far and wide," "Germ warfare, populations in the Northwest will be decimated," and "Who is going to stop these maniacs?"

In microbial control a great deal has been done and the progress has indeed been gratifying. Now as I understand the basic biology, it must be used early in the upswing of the population explosion, build-up must be prevented, and hopefully, an early decline in population numbers will occur prior to suffering severe impact on the forest. So a particularly important element that we must have is an adequate knowledge of population dynamics in order to be alert to the possibilities of an epidemic. We have to have early detection. If we are late on either of these, then any control efforts with microbials will probably be a waste of time and money. In order to use this approach effectively, there will need to be a coordinated effort, and by this, I mean the coordination and use of many disciplines and many skills. We need an effective material, and we need good dependable tools. With these and with a team of skilled and knowledgeable people, the job can be done and done properly. So take this team, throw together in a blender, shake well, add a dash of imagination, and we are in orbit. I do wish to stress that all these elements must be present. We can't do our job and do it properly if one or more of them are missing or inadequate.

It may be quite some time before this will occur. Therefore, I raise the question for your consideration--gentlemen, are we taking a look at the whole problem? Who is looking after the overall coordination and bringing all these things into a balanced effort? Again, I suggest that this is not being done. Will we have the hardware or excellent material and not know when to use them or if it is necessary to use them? I invite your comments.

During the general discussion among panelists and audience it became apparent that to advance microbial control of forest insects the following is needed:

1. Interdisciplinary approach should be used in research and development considering different points of view.

2. A better exchange of information, closer cooperation of research, industry, and pest control will result in more rapid and rational development of operational microbial control methods.

3. Training microbial control specialists is needed to carry out efficiently pest control activities and apply research results into practice as soon as possible.

4. Laboratory and field research and development should be intensified in the areas that offer the most likelihood of success to solve important pest control problems. This need is especially in the phases associated with

the aerial application of microbial insecticides (spray formulation, spray physics, deposit assessment, equipment, and evaluation methods).

About 130 people attended this panel discussion.

PANEL: SCOLYTID PHEROMONES - READY OR NOT

Moderator: G. B. Pitman (substitute for M. D. Atkins)

Participants: D. L. Wood, B. A. Butt, J. A. Chapman

The impetus for this panel stemmed from the paper by M. D. Atkins (Canadian Entomol. 100: 1115-17. 1968) entitled "Scolytid Pheromones - Ready or Not". In this paper Dr. Atkins is concerned with the potential misuse of behavioral regulating materials when and if they become a wide-scale tool for population manipulation. Several points questioning the state of knowledge on this subject were adroitly made. They included adverse effects on predators, parasites and competitors, at what population levels should manipulation be attempted, range of effectiveness of attractive centers, and alteration of gene pools which could shift bark beetle behavior. Such alterations considered were changes in response patterns, i.e., individuals that tend to disperse, selective pressure favoring the development of nonresponders, and changes in sex ratio.

The participating members were asked to address their remarks to these subjects as well as others deemed worthy of consideration. Their replies are listed as follows:

D. L. Wood

Scolytid pheromones have yet to be proved effective in any suppression program. Only carefully controlled experiments under field conditions can demonstrate the feasibility of manipulation using the synthetic attractants now available. The objectives of forest management will be very important in determining if, when and how we will employ attractants in suppression programs. Evaluation of the effectiveness of any suppression effort, including manipulation with pheromones, should include not only estimates of tree mortality but also the within-tree populations both before and after the elected treatment.

Synthetic attractants must compete with natural sources to be effective. The concentration at which aggregation to a point source is inhibited or diverted to other sources is unknown. Because bark beetle pheromones are medleys of compounds, selection pressure on the population will be proportional to the authenticity of the synthetic mixture. Also, because the activity of these compounds is a result of synergism, authenticating the mixture is made more difficult. The sustained use of one combination may cause a gradual shift in response to other combinations that contain compounds that participate in the natural mixture, but are not present in the synthetic mixture. Whether quantity can compensate for deficiencies in quality of the synthetic mixture has not been determined. This is all greatly complicated by the extreme variability in response to identical mixtures and concentrations under field conditions.

Natural enemies respond to synthetic bark beetle pheromones and the impact of their selective destruction cannot be ascertained at this time. When we learn what compounds are important in their aggregation behavior it may be possible to selectively manipulate their populations.

Despite the primitive state of our knowledge, bark beetle pheromones still offer one of the most promising alternatives to the use of synthetic organic insecticides in bark beetle control programs.

B. A. Butt

My answer to "Pheromone - Ready or Not" is that pheromones are ready for survey work and as research tools, but they are not ready for use as control mechanisms. Pheromones have great potential and I think they will be used successfully within the next few years.

I will cite some tests where populations have been reduced, but not controlled by pheromones. I will also discuss confusion tests. Masking materials may also be used.

I do not know of adverse effects caused by Lepidopterous pheromones. There have been very few parasites or predators caught in pheromone traps. I would be concerned about selection if a synthetic pheromone slightly different from the natural pheromone is used. "Gyplure" is an example.

Before we embark on a control program using pheromones, we should know more about:

1. types of dispensers
2. desired rate of pheromone release
3. trap concentration
4. comparison of confusion techniques with trapping insects
5. distances pheromones can attract or confuse 95% of the males.

J. A. Chapman

Pheromones and other chemical attractants offer promise for eventually controlling scolytid beetles. This is not to say it will ever be easy, because of the extensive nature of forests, complex topographic influences, problems of access, etc. But we know that bark and ambrosia beetles depend on odor responses to find new breeding material, and we know other methods of control are costly, indefinite and not promising.

We don't know enough now to use attractants effectively on a large scale. Tests and operational procedures have emphasized many areas of bark beetle biology in which we lack important knowledge for this approach. By recognizing and filling in these gaps, and continuing field studies with chemical attraction we should eventually be in a position to make the most effective attempts to control outbreaks or reduce endemic losses due to bark beetles. If outbreaks tend to develop in certain limited "reserve" areas - - which is debatable - - the time to apply intensive efforts would be when populations there begin to rise sharply. This should prevent development and spread of the outbreak. If, however, epidemics develop simultaneously over wide areas, the outlook for successfully reducing or preventing them by this means is not hopeful, because of the magnitude of the effort needed. Considering the many types of bark beetle problems and many differing forest types where they represent a threat, it is likely that there will be some situations where attractants can be used effectively to reduce losses.

We may assume that all normal bark beetles respond to attractive odors at some time during flight. A big unknown at present, however, is the time during dispersal flights when they become responsive, or what they do in flight when they do not perceive a stimulus. These are key questions and it is important to determine by field experiments what proportion of the overwintered populations in a given area can be drawn to attraction centers there: i.e., what proportion disperses so far before becoming responsive that they leave the area in which they developed.

Many workers have reported low returns of marked scolytids released near sources of attractive odors. I believe many of the failures to retrieve these beetles could have a simple physical explanation involving direction (vertical and horizontal) and rate of dispersion of the odor plumes. I suggest that often the beetles don't encounter plumes from the test sources until they are so far away the concentration of odor is below threshold, or some competing source has attracted them. Our present knowledge of the range of distance over which scolytids typically track odor plumes under average and ideal conditions is almost non-existent. We need much experimental data, secured under conditions where air flow over a large area is known, to answer these questions. Whether odors rise into and through the crown level, and whether beetles tend to carry out dispersal flight above the crowns are relevant questions.

To conclude, considering how best to use chemical attraction against bark beetles helps to identify important gaps in our knowledge of their biology and behavior, e.g., the basic causes and course of their outbreaks, the manner and height of their dispersal flights, the time in flight when they become responsive and how much they fly in the absence of an odor stimulus, the mechanisms by which they maintain upwind flight orientation, and the distribution and dispersal of odors by air currents within the forest environment.

G. B. Pitman

At this time, it is somewhat difficult to speak with any degree of confidence on the use of pheromones in a bark beetle suppression program, due to the lack of extensive field trials. There is room for optimism, however, and I base this optimism on the following points of view.

Aggregating pheromones, such as those found in bark beetles, are by their innate nature highly active compounds. They operate over considerable distances, as opposed to sex attractants, to mark host material for mass invasion that may be temporal in suitability or resistant to individual attacks. The manner in which these chemical messengers control beetle behavior has resulted in a system of high survival value to the species. The key to this survival mechanism is the fact that bark beetle pheromones induce populations to aggregate on or near newly infested material. In the case of the more aggressive Dendroctonus species, such as pseudotsugae, brevicomis, obesus, ponderosae and frontalis, they must attack en masse to overcome host resistance and to successfully establish a new colony. Dr. Atkins has pointed out how in certain species bark beetle pheromones are used to mark widely scattered and very temporary habitats; the survival value in this case is also quite apparent.

Bark beetles, at least in the species we have studied, show a preference for field olfactometers baited with attractant of the highest concentration. This is probably best exemplified by our recent work with D. ponderosae, D. frontalis and D. brevicomis. With appropriate synthetic compounds of insect and host origin we have been able to markedly increase the response to field olfactometers over those baited with natural sources. An absolute prerequisite in using pheromones in an insect suppression scheme is that the synthetics must be highly competitive to a natural source. We feel we can now duplicate the phenomenon of mass aggregation with synthetic attractants, consequently plans are being formulated to test the hypothesis that limited bark beetle populations can be manipulated.

It would seem nearly impossible to predict what impact might occur on the gene pool of a bark beetle population when and if aggregating pheromones become a widespread pest management tool. The subject of population quality is almost completely untouched. Atkins has done some pioneering work on D. pseudotsugae. His results would indicate that this would be a very productive area of research since there appears to be a considerable degree of polarity in terms of behavior both within and between populations. Until the parameters operative in determining population quality can be measured and correctly interpreted I see no way of establishing meaningful dialogue.

There is one point, however, that I think we can discuss. With a regimented use of scolytid pheromones it seems highly improbable that a situation could be created analogous to the one that occurred with the use of DDT on the housefly; in other words, the emergence of a population of resistant (nonresponding) beetles. As previously mentioned, the more aggressive Dendroctonus species, which would undoubtedly be our first target species, must aggregate to survive. If the mechanism of aggregation is genetically linked and we imparted a selective advantage for a population of nonresponders with the application of pheromones, then the beetles must develop an alternative method other than olfaction for host selection and colonization if they are to survive. Development of a population of nonresponders through the use of pheromones appears remote.

It seems reasonable to anticipate, even in view of our scant knowledge on pheromone use, that synthetic attractants will eventually become effective agents for manipulation and consequently regulation of bark beetle populations.

PANEL: ENVIRONMENTAL POLLUTION

Moderator: Philip C. Johnson

Participants: Fred Rabe, Robert F. Tarrant

POLLUTION IN MONTANE RIVER SYSTEMS

Fred Rabe
Assistant Professor of Zoology
University of Idaho

Since most of the emphasis of the presentation was placed on species diversity rather than on bioassay work, only the former topic is included here.

Investigators in the field of water pollution used to place much emphasis on indicator organisms and/or water chemistries. It is now recognized that so-called "indicator" organisms may be found in relatively clean water as well as under polluted conditions. Also, trace amounts of toxic substances may not be detectable by standard chemical methods and may change drastically from day to day.

Benthic macroinvertebrates have been shown to be good indicators of stream conditions. They are fixed in their habitat, spend at least several months of their life cycle in the stream riffle and have various sensitivities to pollutants. It has been demonstrated that association of benthic organisms rather than the presence or absence of single species or types are the best criteria for judging degree of health of a stream.

The structure of the riffle or macroinvertebrate community consists of information of kinds, numbers, and biomass of species present. This information can be summed up as species diversity. In general, a healthy stream is rich in species with no single group predominating, whereas a polluted stream has very few species with large numbers of individuals.

To measure diversity in a riffle, the substrate is sampled (Surber square-foot sampler) and the number of different species and the number of individuals in each species is counted. This information is fitted to the model (Shannon-Wiener function):

(where N is total number of individuals in a sample and n_1 is number of individuals in each species.)

The result will vary from 0 (where all individuals belong to the same species) to a high number as number of species and equitability increases. In this manner different parts of a stream can be compared (above and below and effluent) or the same riffle can be sampled from year to year and results compared and correlated with environmental influences.

Presently we are sampling and comparing invertebrate populations in the clean North Fork and polluted South Fork and Main Coeur d'Alene River in Idaho. Sampling will continue for the next couple of years to ascertain whether or not installation of holding ponds by the mining industry improved conditions in the river as reflected by the benthic populations. Supporting the description of the community structure will be an analysis of certain physical and chemical conditions in the waters.

ATMOSPHERIC POLLUTANTS AND THE FOREST ECOSYSTEM

Robert F. Tarrant
Principal Soil Scientist
U. S. Forest Service, Corvallis, Oregon

The presentation was based upon investigations conducted at Corvallis, Oregon under Research Work Unit FS-PNW-1603 entitled "Behavior of chemicals introduced into the forest environment and their impact on the ecosystem."

An increasingly wide variety of organic and inorganic chemicals is being used on forest and related rangelands of the United States. These chemicals are greatly needed to accomplish critical goals in forest and rangeland management. But along with meeting these production goals, we have a strong responsibility to maintain an unpolluted forest environment.

To guard against deterioration of the forest environment from chemical pollution, we must know better the character, intensity, and causes of pollution from forest practices and the frequency of their occurrence. We need especially to increase our understanding of the metabolism and natural degradation of a wide variety of pollutants. Finally, we need to apply results of our research to developing alternative methods of reducing and controlling pollution in the forest to levels that are not harmful to man, plants, or animals, or methods that will prevent further emission of the pollutants.

Meeting the aforementioned needs and goals for research on forest environmental pollution requires first determining the <u>behavior</u> of chemicals introduced into the forest environment. We must understand better the basic processes of how chemicals are distributed among major elements of the forest ecosystem, how they move about, and how they are retained or released from the forest ecosystem. The great number of chemicals used in a great number of environmental situations precludes empirical determination of individual chemical behavior. Instead, models must be formulated based initially on existing information, improved with field observation and laboratory experimentation, and finally tested by comparing predictions with observed behavior.

We need further to determine the <u>impact</u> of introduced chemicals on major elements of the forest ecosystem. In this portion of the research program, information on behavior of introduced chemicals is applied to problems of determining effects. This area of research will require not only the technical capabilities represented in the Work Unit, but also many others that can be brought to bear on the forest chemical problem only by cooperative effort. Along with research by the Work Unit, a continuing responsibility will be to develop cooperative research wherever required to hasten solutions of problems posed by introduced chemicals in the forest environment.

Research by the Work Unit now includes studies of the fate of DDT after aerial spraying. The persistence of a systemic insecticide, phorate (Thimet) in the forest floor and surface mineral soil is also under study. The introduction of endrin into the forest environment after aerial seeding of Douglas-fir is receiving close scrutiny because of preliminary observations that show that despite the very small amount of endrin used in treating seed, substantial amounts of chlorinated substance tentatively identified as endrin are found in stream water, fish, aquatic insects, and salmon eggs both before and after seeding operations.

A major part of the Work Unit's research is devoted to studying the introduction of herbicides and their degradation in the forest environment. The use of herbicides has increased rapidly during the past few years and high priority is being given to studies of these chemicals. Guidelines have been supplied to forest administrators for improving safety of spraying practices and evidence has been accumulated to indicate that, with proper precautions, the phenoxy herbicides and amitrole can be used without serious impairment of water quality.

A simply stated goal of this research program is to develop facts that will either assure the safety of chemicals being used or point out hazardous chemicals that must not be used in the forest environment. Suggestions for improving the usefulness of the program to entomologists and expressions of interest in areas where cooperation might hasten answers are most welcome.

ATMOSPHERIC POLLUTION AND CONIFEROPHAGOUS INVERTEBRATES

Philip C. Johnson
Principal Entomologist
U. S. Forest Service, Missoula, Montana

Published and unpublished entomological literature of the last half century contains numerous references to suspected or documented associations of airborne toxicants and outbreaks of forest-inhabiting invertebrates. In most of these outbreaks, the toxicants either conditioned coniferous host trees in ways to make them more susceptible to attacks of arthropod pests, or they induced the buildup of epidemic populations of these animals by killing important invertebrate parasites, predators, or competing species that normally keep these populations under control naturally.

Atmospheric pollutants discussed in the presentation ordinarily derive from three main sources:

1. Gaseous or particulate chemical compounds from industrial or urban complexes. These include soot, dust, fly ash, smoke, chemicals (SO_2, H_2SO_4, NO_2, O_3, and others), smog, and "smaze" (smog + haze).

2. Applied pesticides, usually insecticides and herbicides, but including other chemicals foreign to the environment or those applied in abnormal amounts.

3. Photochemical reactions that combine airborne chemicals in the presence of sunlight and other favorable weather conditions to form new compounds.

A number of epizootics of forest invertebrates have been linked to airborne toxicants in past years by forest entomologists in the western parts of the United States and Canada. Several were discussed in some detail since they served to illustrate the action of pollutants in each of the above-mentioned sources.

Smelter Effluents and *Dendroctonus* Infestations

The smelting of certain mineral ores usually emits sulfur dioxide (SO_2), along with arsenic, lead, zinc, and antimony compounds, in order of decreasing importance, according to information supplied by Mr. Robert W. Manchester, Minerals Management and Geology Branch, Division of Recreation and Lands, U. S. Forest Service, Missoula, Montana. Symptoms of SO_2 poisoning in conifers is usually evidenced by the development of chlorosis in the needles which, in turn, reduces photosynthesis and eventual needle killing (Baxter 1943).

Conifers of the Pacific Northwest are variously susceptible to SO_2 damage. Baxter (1943) lists this tolerance as follows:

1. Western larch	Most susceptible to damage
2. Douglas-fir	Most susceptible to damage
3. Ponderosa pine	Most susceptible to damage
4. Engelmann spruce	Less susceptible to damage
5. Western white pine	Less susceptible to damage
6. Western hemlock	Less susceptible to damage
7. Lodgepole pine	Less susceptible to damage
8. Silver fir	Less susceptible to damage
9. White fir	Less susceptible to damage
10. Western red cedar	Less susceptible to damage

Evenden (1923) investigated the role of coniferous trees as hosts for bark beetles in forests exposed to sulfur dioxide fumes emitted by an ore smelter at Kellogg, Idaho from 1918 to 1923. By 1920, severe SO_2 damage to several coniferous species was evident in stands near the smelter. By 1923, the infestation by *Dendroctonus brevicomis* of ponderosa pine trees heavily damaged from SO_2 in previous years was abundant.

A similar study of the incidence of beetle activity in SO_2-damaged Douglas-fir and ponderosa pine trees was made in 1929 at Northport, Washington by Keen and Evenden (1929). Source of the fumes was an ore smelter at Trail, B. C., Canada. From this and a follow-up study in the same area in 1931 by Evenden (1931), it appeared that (1) ponderosa pine and Douglas-fir trees lethally damaged by SO_2 fumes were not attractive to bark beetles, and (2) more moderately damaged trees, particularly ponderosa pine, were more susceptible to attack by bark beetles even during the two or three years they recovered from the fume damage.

Dusts and Scale Insects

A massive infestation of the black pine leaf scale, Nuculaspis californica, at Spokane, Washington, from 1948 to 1950, first thought to be associated with widespread, heavy concentrations of airborne fluorides from an aluminum reduction processing plant, were subsequently found to be associated with heavy concentrations of aerially suspended cement, silicon, and other dusts (Johnson 1950). Dust-associated outbreaks of this insect are frequently reported in ponderosa pine stands in urban and non-urban environments.

Insecticidal Drift and Scale Insects

In 1956 and 1957, the killing of many pole-size and mature ponderosa pine trees by the black pine leaf scale, Nuculaspis californica was investigated by the writer at Cashmere, Washington and at Penticton, B. C., in collaboration with Dr. D. A. Ross, Forest Insect Laboratory, Vernon, B. C. At each location, the infested pine stands were up-slope from commercial fruit orchards. It was hypothesized that DDT-spraying for control of the codling moth in apple orchards resulted in the drifting of this insecticide up-slope into the pine stands where arthropod parasites and predators of the scale were decimated, thus assuring a rapid and unmolested buildup of the latter's population (Struble and Johnson 1964).

DDT and Spider Mites

Outbreaks of the spruce spider mite, Oligonychus ununguis (Acarina: Tetranychidae) were reported in Yellowstone National Park, Wyoming in 1929, Jackson Hole, Wyoming in 1929, in Colorado in 1949, and in Montana in 1957 following the ground and aerial spraying of chemical insecticides to control the spruce budworm in Douglas-fir host forests (Johnson 1958). Other outbreaks of the spider mite are coming to light as old records are studied by contemporary researchers.

It was not until the Montana outbreak of 1957—the largest on record—that the cause-and-effect role of the insecticides, notably DDT, was understood. At that time, forest entomologists at Missoula, Montana sought and received advice from acarologists at the Canadian Department of Agriculture at Summerland, B. C., and at the Washington State Tree Fruit Experiment Station at Wenatchee, Washington. The occurrence of spider mites following use of DDT sprays was a well-known phenomenon in commercial fruit orchards.

The agricultural acarologists reasoned and later demonstrated that the aerially applied DDT used in Montana for controlling the spruce budworm in 1956 killed native populations of several predaceous invertebrates inhabiting the Douglas-fir forests, predominantly:

Typhlodromid mites (Acarina: Phytoseiidae)
A ladybird beetle, genus Stethorus (Coleoptera: Coccinellidae)
A gall midge (Diptera: Cecidomyiidae)
Pirate bugs (Hemiptera: Anthocoridae)

As so commonly occurs in fruit orchards, death of these predators by insecticidal residues released the natural controls of the tetranychid mites, enabling them to develop rapidly to epidemic numbers in the company of favorable climatic and host conditions. The damage from their feeding in the infested Douglas-fir forests in Montana in 1957 was greater in some areas, even, than that from the spruce budworm feeding against which spraying of DDT was originally directed.

Special Environmental Hazards

Most forest entomologists are well aware of the attraction by certain bark and wood-boring beetles to coniferous host trees newly scorched by fire, freshly felled, or of those contributing to fresh-cut slash during timber harvesting or land clearing operations. The attractive elements in this case are the volatile terpenes and other odors placed into the air from these materials. The result is often to hasten the death of injured trees, to lessen their salvage value, or to kill large numbers of living trees in normally uninfested forests because populations of the pest beetles are aggregated or concentrated as they respond to the source of the volatile odors.

Photochemical Oxidants

The chief offender in this group of airborne pollutants is "smog", an acid-containing aerosol produced by photochemical reactions in air. Smog is one or more of several kinds of airborne particulate matter--dust, smoke, soot, fly ash, sulphuric acid, mist, haze, smaze--that absorb many gaseous pollutants, concentrating them and carrying them into direct contact with any kind of surface upon which they can settle.

Kovitz (1967) and Urone (1967) have recently summarized pertinent information about smog in the United States, particularly in the Los Angeles area:

1. Approximately 143 million tons of waste materials are dispersed into the atmosphere annually in the U.S., 60 per cent (85 million tons) of which is from internal combustion engines of automobiles and trucks.

2. There were 10 million registered automobiles and trucks in California in 1967, and this number is increasing at the rate of four per cent per year.

3. One of every 10 gallons of gasoline used by automobiles is lost to the atmosphere because of imperfect combustion--

equivalent to 20.6 million gallons of partially burned gasoline dispersed to the atmosphere each day.

4. This partially burned gasoline represents a monetary loss to the American people of $7 million a day (at 33.3 cents per gallon). And, besides, they have to breathe the stuff.

5. Smog is produced in the Los Angeles area in this manner:

   a) A.M. TO NOON.--Automobile exhaust substances build a reservoir of airborne nitric oxide (NO) and various hydrocarbons.

   b) NOON.--Nitric oxide concentration drops due to photochemical reaction to form nitrogen dioxide (NO_2). As the maximum formation of NO_2 occurs, ozone (O_3) increases in the presence of sunlight.

   c) BY 2:00 P.M.--The air has noticeable amounts of aerosols, ozone, formaldehyde, and nitrogen dioxide. This is the classic "L. A. smog"; brown, fog-like, eye-irritating, and foul-breathing (who wants it?).

   d) AFTER 2:00 P.M.--Smog originating in the L. A. basin is blown up into surrounding pine-forested mountains in late afternoon by on-shore winds.

Thus, we find smog-generated ozone carried by wind out of the L. A. basin to the ponderosa pine forests of the Angeles and the San Bernardino National Forests to set the stage for an intriguing problem involving bark beetles.

Since the early 1950's, pine trees in certain parts of these National Forests have been subjected to a smog-induced disease variously known as "x-disease", "chlorotic decline", or "ozone needle mottle." This disease in recent years has been a predisposing factor in the increasing number of infected trees that have been attacked and killed by the western pine beetle, Dendroctonus brevicomis, and the mountain pine beetle, D. ponderosae (Stark et al. 1968). Collaborating entomologists and pathologists have established a direct relationship between the death of these trees by bark beetles and the incidence of the disease in the trees.

From this brief resume of the effect of airborne pollutants on populations of forest insects, it is obvious that foresters and entomologists should be alert for possible adverse effects on the forest ecosystem of existing industrial-urban complexes. Certainly, they have a stake in the ever-growing industrialization and creeping urban sprawl as these manifestations of civilization closely approach or infiltrate valuable forest properties.

Literature Cited

BAXTER, DOW VAWTER. 1943. Pathology in forest practice. John Wiley and Sons, Inc., New York, N. Y. 618 pp.

EVENDEN, JAMES C. 1923. Smelter killed timber and insects. Unpub. rpt., U. S. Dept. Agr., Bur. Entomol., Forest Insect Lab., Coeur d'Alene, Idaho. 4 pp.

______________. 1931. The role of forest insects in response to timber damage in the smelter fume area near Northport, Washington. Unpub. rpt., U. S. Dept. Agr., Bur. Entomol., Forest Insect Lab., Coeur d'Alene, Idaho. 12 pp.

JOHNSON, PHILIP C. 1950. Entomological aspects of the ponderosa pine blight study, Spokane, Washington. Unpub. rpt., U. S. Dept. Agr., Bur. Entomol. and Plant Quar., Forest Insect Lab., Coeur d'Alene, Idaho. 15 pp.

______________. 1958. Spruce spider mite infestations in northern Rocky Mountain Douglas-fir forests. U. S. Dept. Agr., Forest Serv., Intermountain Forest and Range Expt. Sta., Res. Paper 55. 14 pp.

KEEN, F. P., and JAMES C. EVENDEN. 1929. The role of forest insects in respect to timber damage in the smelter fume area near Northport, Washington. Unpub. rpt., U. S. Dept. Agr., Bur. Entomol., Forest Insect Lab., Stanford Univ., California. 12 pp.

KOVITZ, RAY. 1967. The internal combustion engine and smog. In, Rocky Mountain Region. Conf. on Air Pollution Proc., Univ. Wyoming, Laramie, Wyoming. Pp. 27-37.

STARK, R. W., P. R. MILLER, F. W. COBB, Jr., and OTHERS. 1968. Photochemical oxidant injury and bark beetle (Coleoptera: Scolytidae) infestation of ponderosa pine. Hilgardia 39(6): 121-152.

STRUBLE, GEORGE R., and PHILIP C. JOHNSON. 1964. Black pine-leaf scale. U. S. Dept. Agr., Forest Serv., Forest Pest Leafl. 91. 6 pp.

URONE, PAUL. 1967. Air pollution effects on materials. In, Rocky Mountain Region. Conf. on Air Pollution Proc., Univ. Wyoming, Laramie, Wyoming. Pp. 61-66.

PANEL: SUMMATION AND CRITIQUE

Moderator: A. M. Rivas

Participants: Dr. Kenneth Graham, Dr. James H. Lowe Jr, W. F. McCambridge

The main purpose of the Summation and Critique panel was to gather as much information as possible regarding opinions on the organization and conduct of the meeting as well as the interests of those in attendance. A secondary purpose was to analyze our conference needs and progress.

One hundred questionnaires were used to gather opinions on seven primary questions pertaining to the meeting.

Most respondents (46) indicated there were simultaneous workshops they wanted to attend, only one person indicated that there were no conflicts. Despite the conflicts of workshop interest, it is interesting to note that only 10 people attending the 1969 conference thought there were too many workshops, 30 thought the number about right and 4 thought there should have been more workshops. Note that these opinions were held when the number of workshops was more than twice the 10-year average.

The following table summarizes the scope and general organizational content of our meetings for the past 10 years:

Size and duration of work conferences by years.

Year	Number of workshops	Number of subjects in program	Duration -days-
1969	23	28	4
1968	17	13	4
1967	9	20	4
1966	9	14	4
1965	15	19*	4
1964	4	6	3
1963	5	5	3
1962	10	10	4
1961	4	5	3
1960	5	7	3
	$\bar{X} = 10$	$\bar{X} = 13$	

* Does not include 26 papers, mostly on wildlife-pesticide relationships.

There was a wide range in opinion as to how much time the workshops should take. Most respondents felt that either two-hour or one-to two-hour workshops were most desirable.

We asked whether the number of persons participating in a workshop should be limited or whether this was important. A wide range of opinion was evident in the responses received. The greatest single response, however, was that participation should not be limited.

The number of people signing up for workshops on Tuesday (3/11/69) at 1:00-2:45 p.m. was 27, 8, 29, 17, 8, 41 (for host selection and population survival). For the 3:15-5:00 p.m. workshops the sign-up was: 19, 17, 18, 33, 8, 34. For Thursday 9:00-11:30 a.m. workshops the sign-up was: 13, 2 (insects of deciduous trees and shrubs), 34, 30, 12, 12.

While some of these workshops were large, the number of persons actively participating was never excessive.

Most people (32) responding, felt that the conferences would not be improved if the number of workshops was reduced and the number of panels increased.

The question of scheduling specific workshops did receive definitive direction if not agreement on specified times. Most replies indicated that scheduling should be as needed, depending on the subject, and current developments.

The greatest variety of responses by far were in reply to the question, "What could have been done to improve this conference?" It should be emphasized, however, that the majority of people were generally well satisfied with the meeting, its organization, and the facilities. The following comments represent the tone of the replies received that were not included in any of the responses discussed earlier:

1. Eliminate the "Welcome".
2. Eliminate the "tour", unless it contributes to the meeting agenda or conduct the tour in the evening.
3. Spend less time on "general" discussions opening day, get to the technical part of the meeting right after lunch.
4. Get some newer faces on panels or leading workshops.
5. Make sure chairs, rooms, neck microphones, and other equipment are adequate for our needs.
6. Chairman should control irrelevant discussion, monopoly of expression, stimulate discussion, keep speakers on time.
7. Do not have for a panel, what should be a conference theme.
8. Workshop or panel titles should be indicative of what is to be discussed.
9. Keep delegates room accommodations closer together.
10. Have coffee available continuously.
11. Have fewer pure research and more applied entomology topics.

That summarizes the response to the questionnaire.

As part of an appraisal of the Western Forest Insect Work Conference, the programs for the past 10 years were summarized in order to obtain some idea of the scope and general organization of the meetings.

The number following each title is either the number of persons working in the specific field or the number of studies devoted to the subject according to the 1961 Proceedings canvassing Canadian and United States entomologists (but not all graduate student programs).

Six conferences in the past 10 devoted workshops or panels to: cone and seeds insects (13), control by disease (3), tree resistance (8), attractants (3).

Five conferences in the past 10 had sessions on: control operations, control decisions, insecticide testing (4) population dynamics (8).

Four out of the last 10 conferences had sessions on: avian predation, integrated control (2), survey techniques (3), study methods (4), artificial diets (2).

Three out of the last 10 conferences had sessions on: weather-climate-insect broods (8), trend predictions (7), microorganisms-biology (5), parasites (6), remote sensing (5), control evaluation (1), control objectives.

During two of the last 10 conferences there were workshops or panels on: pesticides-wildlife, environmental pollution, education-training needs, nematodes (1), sucking insects (1), pine shoot moths, insects on saplings (1).

During one conference in the last 10 there was a workshop or panel on: research planning, pesticide effects (on), control equipment, pesticide residues, insect sterilization, forest fertilization-insects, auto-data processing, population sampling (9), photography, lab. design, stand density-infestations (2), natural control-general, biology-ecology (19), insect genetics, insect physiology (1), deciduous trees and shrubs (3), weevils (4), seedling insects.

From the above list of workshops or panels we conclude:

a. Some titles are too broad
b. Our present knowledge of who is doing what is inadequate. We need a more frequently revised list of study titles and names of people from industry, universities and public agencies doing work (not only research but specific control functions) related to forest entomology.

c. Some of the workshop topics might better have been presented as papers. For example, avian predation, nematodes and forest fertilization-insects. In each case there are only a few very highly knowledgeable people working in these fields. It would seem desirable for these people to address the assembled conference rather than to expose their subjects to conflict with other workshops.

d. There are several areas of investigation that are inadequate. For example, there should be studies (research or administrative) on cost-benefit relationships in control and realistic, unemotional methods of reaching control decisions. Recreation as a forest use is a major activity of land managers. Perhaps it is time for studies of insect repellents and individual tree protection from insect attack. Are special problems in insect control in recreation areas receiving adequate attention? There appears to be very little pesticide-wildlife research being carried out by the conference members. This work seems almost entirely in the hands of wildlife managers. This makes as much sense as leaving most of the wildlife research in the hands of the chemical industry. No intention is made here to doubt results of present investigations, but it is obvious that different frameworks of reference are possible. The impact of widespread insect outbreaks on wildlife populations within the framework of man's total needs of forests seems worthy of study.

It appears there is need of a committee to review the study titles and fields of specialty in which the membership is engaged, with the objective of categorizing the work interest into suitable titles for workshops. This might help to minimize conflicts due to simultaneous workshops of similar interest.

The final area of comment is with regard to the direction and progress of the conferences in general. Looking over the program we have just concluded, and reflecting on twenty years of progress since the first meeting, we may detect a number of features of our progress.

We note an increasing awareness of, and concern about the consequences of our actions-the dangers of environmental pollution with such agents as pesticides. We even anticipate the pollution potential of chemical fertilizers proposed for insect control, and the possibilities of new insect problems being provoked by fertilizers used in forestry for yield improvement.

There is a new caution about overselling our own special brand of entomological salvation. We noted that panelists tempered their enthusiasm with a realistic caution, in which they showed awareness of possible pitfalls and limitations in the application of new approaches to pest management.

There is an evident reaching out for new approaches to pest manipulation that would not even have received honorable mention in our earlier meetings: pheromones, sterile males, chemical fertilizers.

We note the increasing enlistment of new technological aids, such as gas chromatography, electrophoresis, electron microscopy and thin layer chromatography that have made possible some of the significant advances reported during the meeting.

It is refreshing to note that the original spirit of the work conference has not faltered. The original informality has been retained, and there is, if anything, a freer exchange of information, and frankness about one's research plans.

It is our sincere hope that these comments may provide some assistance to planners of future conferences.

Workshops: Two workshops "Insects of Deciduous Trees and Shrubs" and "Nematodes in Forest Insects", were either cancelled or not reported because of lack of participation. No report was received for "Stand Density and Insect Outbreaks".

An informal workshop, not on the program, entitled "The Host and Its Relation to Scolytid Biology" was moderated by Rob Reid and is reported.

CHEMICAL FERTILIZERS AS REGULATORS OF INSECT POPULATIONS

Moderator: David G. Fellin

The workshop was attended by 26 people. Because of the limited work being done in this field, it was originally felt that there may be limited interest in a fertilizer workshop but the attendance attested to interest by quite a few individuals.

The discussion began with the description of an exploratory study being done in western Montana to study the effects of the application of N-P-K fertilizers on spruce budworm populations. The work is being done in young stands of western larch, is part of a larger study (1) to determine the effects of these fertilizers on growth of young larch and (2) to measure nutrient concentrations in foliage following fertilization. No data are yet available on the effects of the fertilizer on budworm populations or damage.

There was considerable discussion of the work of several European entomologists involved in fertilizer trials. It was felt that these individuals were still in the "looking" or exploratory stage, just as we are in this country. There was some feeling that the European studies were generally superficial with few or no measurements to support conclusions. Generally they indicate that sucking insects increase and defoliators decrease following fertilizer application. Three individuals, Thalenhorst, Eidemann, and Velensten-Frieburg are now most actively working in the field of insects and fertilizers in Europe.

The work of Ken Graham and one of his graduate students on nitrogen fertilization and balsam woolly aphid populations was summarized and discussed. During this discussion it was mentioned that from the work of silviculturists in the fertilizer field there will no doubt be an impact on many forest insect populations. The point was also made that since nutrient balance is so important to insects, we should be able to exploit this balance by manipulating nutrients and regulate insect populations.

The point was made concerning the use of chemical fertilizers and their effect on the ecosystem. In some areas where considerable fertilization is being done, the water quality may be affected and in some cases, "algal blooms" are developing. It was pointed out that some or many of the nutrients applied do not leach and would tend to be carried away and washed into streams or other water bodies. The nitrates seem to be more and more important. It is of interest that nitrogen is now being applied in quantities as large as 200 pounds per acre, compared to DDT which was distributed at one pound per acre.

It was evident during the discussions that more and more fertilization is being done and sooner or later we must get involved with the study of fertilizers and their direct and indirect effects. It was pointed out that the ideal approach with fertilizer work would be research first and practice later, but the reverse seems to be the case at this time.

Very few people attending the workshop were, or have been, directly involved with studies of fertilization and their effects on insects. This, it seems, is part of the problem. With this situation--we will not be able to put research ahead of practice.

The question was asked, but not entirely answered, "Where do we go from here?" This question prompted some discussion on the approach one would take in laboratory studies. For example, the choice of substrate in growing young trees in the laboratory. Would one attempt to use natural soil brought in from the woods or an artificial substrate? The question also prompted some discussion on the point that we, as forest entomologists, must work closely with researchers and people in other fields; soil scientists, for example.

AERIAL SURVEYS--NEW TECHNIQUES

Moderator: Jerry A. E. Knopf

The original intent of this workshop was to cover recent and/or new techniques for aerial detection surveys. As individuals were contacted prior to the work conference, it was obvious that considerable interest was being focused on remote sensing with primary emphasis directed toward aerial color photography. Therefore, arrangements were made to have three speakers present information relating to their specific photographic techniques, procedures, and applications. Following is a resume of the presentations:

MINI-AERIAL STEREO PHOTOGRAPHY - A CONCEPT

W. H. Klein

Forest managers have access to large format resource photography but lack the capacity to produce timely aerial photography if the need arises. Of the several photographic systems available, 35-mm aerial photography has been used successfully in geologic exploration and shows promise as having application in forestry. Good 3-dimensional color imagery can be obtained from a light aircraft with a standard 35-mm camera. The stereo pairs can then be viewed and interpreted in the office or the field. This system has the advantages of being simple, inexpensive, and extremely versatile. Its most serious shortcoming is its small format and corresponding small scale. Nevertheless, the advantages outweigh the disadvantages. Based on the experience of the author, it has very definite application in forest entomology. The main disadvantage of this small format photography is the small scale required for extensive photo/ground coverage. This is a serious limitation, particularly if the need is to discern detailed objects and still maintain broad coverage. A second limitation, although not particularly serious, is that annotation on the transparencies is impractical because of the small size. This, then, is the decision that the interpreter must make in deciding for or against a particular type of photography. First, he must decide on what he wants to see, and second, he must also decide on just how clearly he needs to see it. For our purpose, however, we feel that the advantages of this simple and effective system far outweigh its apparent limitations. To sum up, we hope to utilize 35-mm aerial color photography in the following ways:

1. Provide the resource manager with an effective and timely picture of insect damage.
2. Permit accurate sampling of discernible bark beetle activity over extensive areas. This will require larger scales and will be tied in with existing resource photography. With a standard aircraft, scales of 1:4,000 are within our present capabilities. With a slower flying helicopter, even larger scales can be obtained.
3. Aid ground evaluation crews in locating infestation centers in inaccessible areas.
4. Facilitate bark beetle control planning.
5. Serve as an aid in training aerial observers.

The real advantage of this mini-system is that it can be used by anyone with a desire for timely aerial photography who has access to a high-wing monoplane and 35-mm camera, and who possesses a general understanding of basic photography (5). In the western forests, for example, aerial fire patrols are now routine, and what better opportunity will a forest manager have for color stereo photography of a fresh clearcut, tentative bridge site, or potential recreation area. Although he does not have ready access to the sophisticated viewing systems discussed here, with some imagination, he should be able to devise his own.

OPERATIONAL USE OF INFRARED COLOR PHOTOGRAPHY FOR ESTIMATING POPULATION LEVELS OF SOUTHERN PINE BEETLE INFESTATION

W. M. Ciesla

At the first workshop on infrared color photography in the plant sciences sponsored by the Florida Department of Agriculture in 1967, I described a technique for estimating the number of trees infested by the southern pine beetle, *Dendroctonus frontalis*, using color aerial photography. Both color and false-color films were evaluated for this application and Ektachrome Infrared Aero film was found to be superior because of its capability of penetrating atmospheric haze and differentiating between pines and hardwoods. The development of this survey method was a challenging and exciting undertaking. However, more challenging yet was putting this survey method into operation over the 13 states which comprise the Southeastern Area of the U. S. Forest Service. The purpose of this paper is to discuss some of the problems we encountered in putting a highly sophisticated insect survey method into practice and how they were solved. Color aerial photography is an excellent tool for estimating population levels of the southern pine beetle. It is the most accurate technique currently available; aerial photographs can be studied in detail in the comfortable environment of an air-conditioned office as opposed to aerial observers attempting to map infestations from aircraft traveling at 100-120 MPH; thus ommission errors are eliminated to a large degree. This system has a built-in safety factor in that aerial photographs are taken at higher altitudes thus eliminating the hazards of downdrafts and turbulence that are common at 500-1,000 feet, the altitudes at which previous bark beetle surveys were flown. The time spent in ground checking is significantly reduced because the aerial photos provide an accurate map showing the location of the infestations. A half-million-acre outbreak can be photographed in approximately two hours, whereas aerial observers generally spent 6-8 hours in the air.

AERIAL SURVEY TECHNIQUES AND REMOTE SENSING

John Wear

Aerial surveys are an economical means of detecting and evaluating outbreaks of forest pests. More aerial techniques research has been devoted to forest insect survey problems during the past 20 years than for disease problems. Consequently, the operational survey methods I'll be discussing are primarily for forest insect surveys, but some disease surveys use the same general aerial techniques. However, new aerial techniques are being tested and developed both for insect and disease surveys.

Since World War II many types of aircraft and a few helicopter types have been used on forest insect surveys in the United States and Canada. The greatest proportion of flying is on the planned detection survey to locate the occurrence of insect infestations in their early stages. The boundaries of the infestations and the approximate intensity of the damage (for some 30 species of insects and several diseases in the Northwest) are delineated on maps of different scales or on small-scale aerial photographs. These surveys supplement voluntary ground detection and reporting by cooperators and are the basis for making more detailed surveys to size up the threat and judge the advisability of control. By direct visual observations and sketch-mapping of infestations over which the aircraft is flying vast forested areas can be covered in a relatively short time at very low cost (20 cents per 1,000 acres). Detection survey procedures worked out for forest infestations in western regions include: (1) standards for damage intensity classes, (2) timing of surveys to coincide with maximum visible damage, and (3) determination of optimum flying heights.

Appraisal surveys to determine the amount of damage caused by certain insect epidemics can often be done most efficiently by a combination of aerial photography and field checking. Usually the more spectacular types of damage (in large centers) caused by forest insects at epidemic levels show on panch-romatic photographs. New types of color film like Ektachrome Infrared, however, are much more effective in discriminating tree damage or tree mortality even at endemic levels. Ektachrome Aero and Anscochrome D-200 color films have been used on operational surveys in all parts of the Nation for many years. Not only do the color photographs provide a base from which the number of dead or dying trees can be estimated with reasonable accuracy but they also are suitable for making direct volume estimates needed to assess the impact of the outbreak on the forest resource. Decisions on possible salvage or control operations are influenced by this impact. Field work is expedited and simplified by the use of properly delineated photos. The photos are a permanent record that can be studied and compared with future reassessments of damage for historical significance or trend. A key factor in the use of photos is that information can be positively field checked, which is virtually impossible to do with visual observations.

The new space age technology is providing some exciting new survey tools that are being tested at the present time to evaluate the impact of forest pests. Studies are now in progress to maximize parts of the electro magnetic spectrum beyond the visible range (.4 to .7 micron) to discriminate healthy trees from those affected by either insects or disease. Ektachrome Infrared color film (.4 to .9 micron), effective in identifying diseased cereal crops, may prove to be a valuable sensor for trees under stress. The infrared portions of the spectrum (2.0-2.6 microns, 4.5-5.5 microns, and 8.0-14.0 microns) are also being studied in ponderosa pine stands of the Black Hills to detect previsual symptoms of trees infested with Black Hills beetle.

Promising results obtained from a non-imaging infrared heat sensor in the 8.0 to 14.0 micron band discriminate healthy trees from those infected with Poria weirii root rot in Douglas-fir stands in Washington. (slides.) This research is jointly sponsored by the U.S. Forest Service and NASA (part of the Earth Resource Evaluation Program by orbiting satellites).

In conclusion, many aerial survey techniques are available for measuring the impact of forest pests on the forest resources of the United States. New or improved techniques are developed each year. Visual and photographic methods expedite the gathering of information at a considerable saving in manpower, time, and costs.

The future holds many exciting possibilities to improve aerial surveys and provide new survey technology to solve pest problems. Some new techniques are in the limited operational stage--some are just on the horizon. By a combination of aerial and ground surveys, appropriate data on insect and disease populations and tree damage, and suitable analytical procedures, the forest managers can effectively fulfill his pest control responsibilities in the administration of the forest resources of the Nation.

EFFECTS OF CACODYLIC ACID AND OTHER HERBICIDES ON FOREST INSECTS

Moderator: Gary B. Pitman

Secretary: Leroy Williamson

The current status of recent investigations into the possible use of fast-acting herbicides, particularly cacodylic acid, to manipulate and destroy bark beetles was discussed. The effectiveness, techniques of application, mode of action, degree of attractiveness to bark beetles following tree injections and effects of cacodylic acid on the environment received emphasis. Interest has more recently been generated in Europe on the use of cacodylic acid.

Cacodylic acid has been tested for control of *Dendroctonus brevicomis*, *D. frontalis*, *D. obesus*, *D. ponderosae* and *Ips lecontei*. Techniques used included pre-flight and post-flight injections in both standing and felled trees, ax and saw frills, and complete girdling and partial girdling for the arsinic acid injection. The general consensus was that timing and method of application is the most important consideration in evaluating the potential of the chemical as a control tool. Trees could be predisposed to attack by various bark beetle species following cacodylic acid treatment. The degree of control obtained for some species appeared very encouraging in tests completed. There is, however, variation among tree and beetle species that limits the effectiveness of any single technique. For example, since D. ponderosae requires feeding for release of attractant, injected trees causing aborted attacks would not be an effective trapping technique. Predisposed trees for D. frontalis, which does not require feeding, might be used successfully.

The possible hazard from secondary bark beetles invading injected trees was mentioned. In the 1940's use of cacodylic acid in ponderosa pine resulted in an outbreak of Ips and subsequent loss of interest in further use. This matter is included in additional studies; preliminary indications are that this problem can be compensated for by altering techniques or will not pose difficulties under existing conditions.

The mode of action of cacodylic acid in a tree remains an enigma. Theories offered by the manufacturer, Ansul Company, are that cacodylic acid causes cambial dessication or enzyme imbalance. The effect on insect development appears to be indirect through adversely affecting brood habitat; cacodylic acid in the tree tissue has not been shown to possess toxic properties. Topical application of concentrated cacodylic acid on D. frontalis adults was not lethal.

According to the manufacturer, environmental contamination from the use of cacodylic acid in trees is remote. The chemical is quickly bound in the soil, it has a $L.D._{50}$ rating of 1700 mg/kg, and carcenogenic properties have been almost totally disproven. Cacodylic acid has been used in medicinal preparations and does not build up in body tissue.

Other herbicides tested were MSMA (monosodium methane arsenate) and Tordon. MSMA is comparable to cacodylic acid in effectiveness in killing trees and reducing beetle brood. Tordon was reported to work more slowly and tended to collect Ips, which survived treatment.

BARK BEETLE POPULATION DYNAMICS

Moderator: A. A. Berryman

It was suggested that the various workers involved in bark beetle population studies review their progress over the last year.

Studies on western pine beetle in California (reviewed by C. J. DeMars)

1. Monograph on w.p.b. population dynamics covering the last 7 years in final review process; is to be published in Hilgardia.

2. Sampling methods include strip aerial photos and ground sampling

5-8 trees. Sample size 100 cm^2 disks.

3. Problems in identifying larval instars when constructing life tables.

4. Ponderosa pine mortality was confined to high density stands where trees were under stress from lack of underground water. Trend from pure pine to mixed conifer association brought about by group killing.

Studies on mountain pine beetle in Utah (reviewed by Walt Cole)

1. Emphasized views on biological, single gallery or family, sampling. Better data because of personal interest of sampler. Problems in intermixing not apparent in m.p.b.

2. Sampling occurs in endemic populations because answers on regulating factors will be there.

3. Emphasized probabilistic approach to life table work; i.e., what is probability of certain events occurring?

4. Interested in identifying the suitable host in terms of nutritional components of phloem. Finds that phloem thickness is important in brood production.

Mountain pine beetle in Alberta (Les Safranyik)

1. There is a strong relationship between beetle size and bark thickness which seems to be associated with moisture.

2. Has developed curve for estimating surface area of bark using DBH and tree height.

Fir engraver in Idaho (Alan Berryman)

1. Major density-dependent within-tree mortality factor is intraspecific competition.

2. He hypothesizes that major factor regulating population size is quantity of susceptible hosts, the mechanism of regulation being intraspecific competition which is a function of population size and food quantity.

3. Emphasized the importance of the host in bark beetle population dynamics and necessity for developing methods to sample host tree populations as well as bark beetle populations.

Southern pine beetle (Bob Thatcher)

1. Noted very high emergence densities with s.p.b. (greater than 2000 per ft^2).

2. Outbreaks appear to be associated with slow growth and weakened trees.

<u>Ambrosia beetles</u> (John Chapman)

1. Feels that ambrosia beetles are a man-made problem.

2. He emphasized the importance of nutrition in bark beetle population studies.

<u>General discussion</u>

1. Precision and accuracy of sampling: Some participants felt that too much time and effort were allocated to obtaining precise estimates. What is an acceptable error? Although there was no general agreement I think the concensus was that more statistical work is needed in defining "acceptable error" in terms of animal population changes, which are usually logarithmic.

2. A short discussion centered on the need for strong economic guidelines in forest insect decision making. Also discussed were management problems, particularly in connection with different areas (i.e., management in the South versus storing trees on the stump in the West).

CONE AND SEED INSECTS

Moderator: A. F. Hedlin

Participants: Mona Lambden, Gustafson, Roe, Hunt, Kinzer, Stoszek, Dale, Kobayashi, Edson, Cerezke, Cameron, Brignel, Wilson, Fossum, Marr, Dewey, Koerber, Hedlin.

Workshop opened with each person briefly expressing his particular interest. Interests ranged from those concerned with specific cone and seed insect problems to those interested in hearing of work being done. Some of the problems under study are:

Spruce budworm on Douglas fir	- Alberta, Montana
Pine seed orchards	- Japan
Chemical Control	- Weyerhaeuser Co., B.C., California
Engelmann spruce	- Montana
White spruce	- B.C.

Chemical Control -
Koerber - Tested lindane, zectran, dimethoate, DDT against Ponderosa

DEFOLIATOR REARING

Moderator: Cal SooHoo

The workshop on defoliator rearing used the morning panel discussion as the jump off point. The matter of using artificial media designed to each separate insect was reviewed in view of the fact that most diets were very similar in composition. Since nutrition per se was not the ultimate aim of rearing but success was, it was concluded that overabundance of materials was a virtue within limits providing insect material thrived. The group examined the uses of antibiotics, filler and binding materials used in conjunction with the primary dietary constituents. Potato starch did not appear to replace costly agar at this point.

The difficulties of rearing a continuous supply of insect material was a universal problem because even the best operations experienced up to 80% mortality in their insects. It was decided that manipulations of existing diets might be quicker than starting from scratch with those diets exhibiting some success.

Manipulations of environmental factors might encourage mating and oviposition. Techniques describing the uses of artificial mating and ovipositional sites were discussed. Waxed paper and paper toweling was used by several investigators for convenience. The breaking of diapause and the utilization of diapause allowed the entomologist in the laboratory with flexibility in controlling his material.

Gustatory stimulants such as the sugars were examined for their purpose on several insect diets. The use of expressed juices and of lyophilized plant material in artificial diets was examined. The failures of some preprepared diets might be attributed in one ingredient contained in the diet. The most obvious was the degradation of the oils in wheat germ. It was generally concluded that in order to improve yield, steps would be necessary to prevent the large numbers of young insects from succumbing.

SURVEY POPULATION SAMPLING

Moderator: Bob Stevenson

A general agreement on the needs for measurement and evaluation of insect populations with regard to forest insect surveys includes the practical purpose of judging hazards and considering protective action. This direction is classified as the extensive approach. Normally this is followed-up by an intensive survey to precisely assess the influence of natural or introduced factors in the environment.

Some considerations noteworthy in measurement of insect populations include timing, mechanics, selection of the universe and sampling unit and conditions within a given stand. Generally speaking an assessment of insect feeding is based on any one of 3 indicators of insect numbers; e.g., matamorphic stages, severity of damage due to feeding and the abundance of frass.

In most instances direct counts are the easiest to obtain and interpret. Also, insects always precede their symptoms. For these, particularly the bark beetles, direct counts provide an estimate of damage. Other methods are applicable to defoliators particularly in the upper crowns of dominant trees. When considering the wide coverage of a forested area, visible symptoms viz. extent of defoliation (light, moderate or severe) have been more useful for survey purposes than direct counts.

With the foregoing in mind, the subject of sampling methods used by survey groups in western North America commenced. The discussion consisted of 2 parts: one on bark beetles and the other, defoliators.

Discussions on Dendroctonus bark beetles centered around the value of sequential sampling techniques for predicting outbreaks. Apparently sequential sampling for bark beetles has not proven too reliable for predicting population trends. Moreover, pilot experiments with new "sensing films" have merit for specific problem areas but not for widespread general use. Even the use of aircraft, popularly acclaimed to be foremost in a detecting system has been reduced in some areas. More emphasis is being placed on ground surveys coupled with an understanding of timber resources and inventories. In fact, regardless of the beetle species, survey personnel believe a more intimate knowledge of the timber conditions within a given region must be fundamental for future work. For example, survey groups would like to be in position to predetermine or predict outbreak on the basis of existing forest conditions. Recently, survey personnel in portions of the Rocky Mountains Region have had success in documenting outbreaks prior to the occurrence of the actual outbreak. Such conditions as wind-thrown timber or an excessive amount of slash on cutovers must be located and disposed of. In essence, closer liaison with forest inventory and management personnel provides the key to this approach. An increase in ground surveys augmented with a re-assignment of research personnel to survey problems along with closer communication with industry is helping to overcome some of the perenial problems.

An indication of more experimentation on detection techniques using the electro-magnetic spectrum and infra-red scanner for pre-visual symptoms between unattacked and attacked bark beetle trees has been promising. However, one major difficulty of detecting spruce beetle attacked trees is the association of other tree species each of which is infested with its own organisms. This problem is common in Montana and northern Idaho.

Of the bark beetle problems the current spruce beetle (D. obesus) outbreak in northern Montana, southeastern British Columbia and southwestern Alberta is the most outstanding survey problem. A minor departure from regular detection techniques has been employed by scanning suspected beetle infested trees in the spring (snow on ground) for woodpecker rings. Stands found exhibiting this characteristic are inspected later by experienced ground crews. Field glasses are used to detect bark beetle activity in the upper bole.

Despite increased attention to management programs and a major realignment of cutting priorities to removed insect infested timber, sizeable volumes have not been salvaged. Many of these outbreaks encompass unmanageable areas, logging leave strips or management units unsalable because operators are already operating to capacity.

Detection of defoliating insects and the determination of insect distribution and relative abundance relies heavily on fixed-wing aircraft operating along a transect line on a grid system or simply remapping previous outbreaks. All regions compliment aerial surveys with ground checks. Experienced ground survey parties appraise the damage using the following criteria: incidence of tree mortality on a unit basis, condition of regeneration, nature of cone production, deformaties to smaller trees particularly in Xmas tree plantations. Where possible, absolute density based on units that cannot vary helps to reveal trends from year to year. This allows an insight into the influence of all environmental factors, including a changing food supply. Predictions of epicenters can be obtained from these studies; e.g., evaluation of population reservoirs from which populations may spread.

With increased emphasis on multiple-use and the management of forest land, insect problems and their relationship to the use and value of an area are being considered before attempting to control the insect problem. High use recreation areas deserve special treatment and their insect problems cannot always be handled in the same fashion as if they occurred in forest management units. Moreover, additional attention is being focused on tying the population level present in a stand to the degree of damage. This type of study is being pursued in the Intermountain Region and in northern Alberta with the spruce budworm.

In summary, all survey units seem to be employing rather standard techniques for general detection purposes. The main problem exists in the appraisal work. For example, many common means of assessing damage are available and supposedly understood but no "vehicle" exists to compare the effectiveness of these. For this reason they are not being used and no one region has a way of exchanging its ideas with those of its neighbours. Of any of the problems discussed it seems that communication amongst the various survey units is the most critical question before us. With the foregoing in mind, the W.F.I.W.C. is the major "key" to solving this problem.

BARK BEETLE REARING

Moderator: R. F. Schmitz

The workshop was attended by 17 members who introduced themselves and their areas of interest. Reasons given for rearing bark beetles included studying fungal relationships, serum protein, environmental entrainment, associated mites, pheromones, mating activities, bioassay of cacodylic acid, and flight mill tests.

Despite the recognition that heterogeneity exists in bark beetle populations little selection is exercised in collecting field populations for laboratory rearing. The lack of objective criteria to distinguish population differences has to date prevented such management. The problem is further complicated by the large numbers of beetles that are often needed to initiate rearing, precluding any detailed examination of field populations.

In general, beetle populations selected for laboratory rearing are collected from trees having the largest brood density per unit area. Some studies, such as those involving associated blue staining fungi, require the selection of a discrete population. Preliminary results from the pedigreed rearing of four generations of mountain pine beetle revealed an apparent decline in brood survival--possibly due to a host factor. In addition, areas of the cuticle of some beetles appear to be incompletely tanned. Discussion revealed that incomplete tanning may be attributable to a dilution or loss of microorganisms, particularly yeast. It is apparent that little has been done to assess the effects of laboratory rearing on bark beetles.

Similarly, knowledge of studies designed to measure or eliminate variation in beetle populations undergoing serial rearing was lacking. The group recognized the need for criteria to identify the "constitution" or genetic quality of beetles used for test purposes. Sex ratio, fecundity and size were suggested as conventional criteria that might be considered. Current investigations of physiological responses and flight performance may provide valuable additional criteria.

The question of how one selects host material for rearing was also considered. In general, trees having thick phloem are more productive of brood in the laboratory. Lodgepole pine cut in the dormant period has been found unsatisfactory for rearing mountain pine beetle, whereas ponderosa and western white pine cut then, have been productive.

Storing host material cut during the summer for subsequent use has some limitations. Experience has shown that water eventually concentrates in the lower side or end of cut logs and therefore such logs differ in their brood production. This discussion also revealed the availability of a grafting compound that does not require heating and is superior to wax for sealing exposed or cut surfaces of rearing bolts in the field.

Adaptation of artificial media to mass rearing has not been attempted because of the problems encountered in formulating a diet suitable for oviposition. In one instance artificial media retarded microorganisms growth and resulted in failure of beetles to oviposit. Oviposition was obtained when the diet was changed to favor microorganisms. In preparing artificial diets in which there is a need to grind phloem in the absence of water, dry ice may be substituted for the water.

Finally, the question of how best to obtain beetles free of nematodes and mites was considered. While no practical method was forthcoming, it was noted that mites have been found to feed on certain nematodes that parasitize Ips. If the nematodes were eliminated, the mites were unable to survive.

MAMMALIAN AND AVIAN PREDATORS

Moderator: D. L. Dahlsten

Participants: N. E. Alexander, R. Gustafson, R. C. Hall, T. Koerber, A. Olson, M. Richmond, G. Ringold, P. J. Shea, and W. J. Turnock.

The group initially discussed the research projects that were currently in progress. Much of the emphasis was on programs in the western United States but Bill Turnock brought the group up-to-date on projects in Michigan, Minnesota and eastern Canada.

Most of the work in the western United States has been concentrated on the hole-nesting birds, namely woodpeckers, chickadees, nuthatches and creepers. The Canadians are still doing considerable work on evaluating the effect of mammalian predators of sawfly cocoons. Generally it was felt that more work should be done with the shrews and other small primarily insectrivorous mammals.

The shrew introduction program in Newfoundland was discussed in some detail. This introduced the general topic of biological control programs involving the introduction of vertebrate predators. Some felt that there might be considerable pressure against such introductions particularly in the United States because of past experience with the starling and the English sparrow.

Augmentation was discussed as a means of increasing vertebrate predators. A great deal of this type of work has been done in the European countries with hole-nesting birds. Nesting boxes have been shown to increase the number of birds per acre but it was pointed out that the exact role of birds in the population dynamics of forest insects was not known. Snag removal as a forest practice was considered. Removal of nesting sites could have a detrimental effect on the forest avifauna. Nesting box programs may become increasingly important in North American forests if this is the case. Stand diversity was mentioned as another means of maintaining larger populations of birds. The group encouraged forest managers to manage their forests for diversity and to allow some stands to become over mature.

Augmentation attempts with small mammals are almost unknown. However, one project in a plantation in New York in the 1940's was quite successful in protecting larch from the larch sawfly.

Much attention has been focused on the functional responses of birds and the group felt that possibly more attention should be given to the numerical response. Some studies have indicated that resident birds are not near as important as those birds that pass through infestation centers in flocks. It was pointed out that diverse stands might entice flocks into an area.

Ralph Hall briefly outlined his project on the great basin tent caterpillar. Several vertebrate predators were discovered that were thought to have some potential. Deer mice, voles, chipmunks, golden mantle ground squirrels and Lewis woodpeckers were the predators studied.

Don Dahlsten discussed the use of nesting boxes in studying mountain chickadees in California. Nesting boxes were shown to increase the numbers of nesting pairs in 75 acre plots. The boxes were also useful in studying the biology of the chickadees and in evaluating the effects of DDT on fecundity. Merle Richmond announced that the U. S. Fish and Wildlife Service planned to use nesting boxes in an insecticide evaluation project.

There have been a number of studies of vertebrate predators of forest insects but the group felt that more consideration should be given to the small mammalian insectivores. There has been a paucity of studies on the numerical responses of vertebrates in relation to the functional responses and researchers should put more effort into studying the former. Finally, mammalian and avian predators may be manipulated either through introduction or augmentation and forest entomologists should give more serious consideration to initiating investigations in this area.

HOST SELECTION AND POPULATION SURVIVAL

Moderator: Rob Reid

Limited time permitted discussion of one aspect only of the broad topic described in the title; that was primary attraction. Invited participants and other members of the workshop gave brief accounts, mainly observational, and dealing with scolytids.

The belief is held by some that host selection, in the primary sense, is random and only becomes non-random when insect initiated aggregating pheromes are released from the tree. However, in the chairman's view, the consensus of the group was that a primary attractant functioned prior to the secondary or aggregating attractant. Views were expressed that an all or none situation was unlikely to occur, and that species of scolytids likely varied in their sensitivity to primary attractants.

It will be recalled that random versus non-random selection was the topic of a hotly debated workshop several years ago. Opinions then were more evenly divided.

Outstanding research on scolytid aggregation and pheromes over the past decade has done much to improve our knowledge, relating particularly to secondary attraction. Perhaps in the ensuing decade research of comparable excellence will provide quantitative information on the role, if any, of primary attraction. If primary attraction plays an important role in scolytid outbreaks, knowledge of its function and influence will be important attributes of prediction and control practices.

PREDATOR-PARASITE INTRODUCTION, PROPAGATION, AND RELEASE

Moderator: Don Schmiege

Recorder: "Torgie" Torgersen

The discussion opened with some general ground rules that were based on personal preferences of the moderator. They included the belief that workshops should be a place for everyone to enter into informal discussions and state their opinions. Workshops should not be a "platform" for someone to present detailed results of a research project that will later appear in the literature. No objection to this appeared, so informal discussions were the rule throughout.

Since several Canadian entomologists were present, discussion began with work on introducing parasites for use against the larch sawfly. Some of the entomologists studying the sawfly now believe that it is a native pest in North America, but larch sawflies have also been introduced resulting in populations with a different genetic makeup and different capabilities. This could account for inconsistent results found in the ability of the sawfly to encapsulate the parasite Mesolieus tenthridinis.

Some unpublished results of work with the parasite Olesocampe benefactor were also presented. Parasitism by this species resulted in a great reduction in the size of the host sawfly. Recovery distance of this parasite increased with a reduction in host population. Parasitism of up to 20 percent to 30 percent has been found.

Single-species versus multiple-species parasite introduction was discussed and the general consensus favored multiple-species. Canadian workers have used both approaches, but those present favored the release of all parasites believed potentially beneficial in controlling the pest population. It was also brought out that searches in foreign countries for possible parasites to introduce should be concentrated in areas where the host population is low.

Establishment of parasites after years of apparent failure was also reported. A possible explanation is that this could be the result of a specific segment of the parasite gene pool selected.

The program of introducing the parasite Agathis pumila for controlling the larch casebearer in the western larch stands was discussed. In general, results to date have not been encouraging even though a high degree of parasitism has been found in local areas. The parasite has not dispersed rapidly and several members commented on the possible reasons for this. If host populations remain high, there is little pressure to disperse. Comparisons should be made of different host densities to check this. Parasite releases have consisted of adult insects and introducing branches containing parasitized casebearers. It was believed by some of us present that releasing branches containing an unknown number of parasites was not advisable. Results would be more difficult to evaluate in any case. Several members present hoped that the personnel working on this project would not become discouraged and discontinue the work. This type of program is often long-term and a premature halt would be very damaging to biological control in general and the western larch stands in particular.

RESEARCH PROGRAM FORMULATION

Moderator: Bob Thatcher

Secretary: Garry Boss

The workshop discussion began with a question on exactly what were the conferees interested in as this related to research program formulation. Were they interested in program organization at all levels within an agency or more interested in individual project programs? It was apparent that we would have to concern ourselves with discussing organization of shorter term projects in particular subject area fields versus consideration of larger programs dealing with many aspects of larger problems.

When and how does one initiate a research investigation, how is it carried out, and when does it terminate? It was felt that a program should be undertaken when there is evidence of a need for more information on a particular problem or series of related problems. The program would be organized into specific projects with particular goals reflecting priority needs. Continued investigation would be terminated when satisfactory results were obtained or investigations had proceeded to the limit of the investigator's abilities to solve the problems. If further information was desired or required, this would have to be accomplished by acquiring personnel with other talents, by training incumbents to handle other lines of work, or by "farming" the work out to other groups. How to best accomplish this additional research was subject to a wide divergence of opinion.

Ideally, it appeared that importing or adding personnel to accomplish additional research needs would best answer the problem of research continuity within a given organization. It was recognized that this was complicated by such factors as 1) the administrator's ability to locate persons with specific talents, 2) whether a new specialist would be interested in pursuing a given line of work through to completion, 3) the limitations of funding and facilities support or the research environment, and 4) the willingness of specialists to move to new locations in support of changing needs. The question of long-term involvement in research, particularly at universities, was discussed. These institutions and other agencies involved in research have different outlooks and objectives. The university is interested in guiding students through an academic development program, in developing an ability to think and question, and in formulating a research program that will add to our knowledge and contribute to a thesis in a reasonable period of time. To carry on longer term programs, the professor must subdivide the program into complimentary projects and recruit or seek a series of interested, qualified students. This is often difficult to accomplish.

Other organizations involved in long-term research have sideboards on their programs in terms of overall program objectives but generally have more flexibility in timing. The problems then evolve down to the most effective use of available manpower to accomplish research goals, to get additional assistance where needed, and to shift research emphasis as goals are achieved or more critical needs must be met.

WORK SHOP SUMMARY MECHANICS OF CONTROL OPERATIONS

Moderator: G. Trostle

It was decided by those in attendance to limit our discussion to two questions:

1. How do field personnel set up a control operation?
2. What should be included in the training of technicians that may be used in control projects?

The members of the workshop had various solutions to the above problems, but in general it was agreed that the following were important points to be considered at the administrative level:

1. Currently, competent personnel have received their training by assignments to various projects.

2. Some thought should therefore be given to the preparation of a personnel plan that would assure the continued training of people in the administration of control.

3. Trained personnel should be made available to other than his local area.

4. The background of the project leader in either entomology or forest administration is not so important as his abilities to communicate and organize.

5. Project leader must have people assigned to him upon whom he may rely to provide accurate up-to-date information on each phase of the project.

6. The more experience the project leader has, the better will be his evaluation of the information he receives from the specialist.

7. Contract specialist must also have a continuous training program to update his knowledge.

8. Canadian technical training programs assist in the training of these specialists.

The two most important items needed by people involved in control are:

1. A handbook of procedures to assure that all phases are included in the planning and a flow chart which may be followed through the entire project to assure that each phase is covered at the opportune time. This book should be made so that information is easily added or replaced.

2. A critique written on each project. Upon the completion of a project, the work should be evaluated in a report written for other personnel involved in pest control that would point up the errors that were made and weakness noted with suggested methods to improve future projects. People are reluctant to freely discuss their mistakes, because of criticism.

The lower echelon positions on control projects are usually filled with college students, state or private forestry personnel, technical students, and experienced forest personnel. In any control project, it is becoming increasingly important to be assured that each phase be examined by competent personnel and safeguards applied during the project to avoid "slip-ups" that might be detrimental to the environment.

AGGREGATION BEHAVIOR AND MANIPULATION OF BARK BEETLE POPULATIONS

Moderator: J. P. Vité

Nineteen sixty-nine will be the first year in which synthetic attractants are available for field tests in the manipulation of bark beetle populations. The discussion centered, therefore, mostly on speculations, how synthetics may best be used. Major points of discussion were:

(1) Use of attractants as survey tool. In general, it was felt that synthetics might be helpful in aiding survey of bark beetle populations as well as their predator and parasite populations For instance, brevicomin was found to attract _Temnochila virescens_ and _Medetera_ species, while frontalin attracts _Thanasimus dubius_. Possible difficulties, however, may be encountered due to positional effects of survey traps and competition from natural occuring sources of attraction. It was suggested that such difficulties may be overcome by the establishment of certain concentrations in which the various components of the attractants are used.

(2) The differences in aggregation behavior of _Dendroctonus ponderosae_,

D. brevicomis, *D. frontalis* to host and insect-produced odors, and of *Ips confusus* to pheromones were debated, especially their potential impact on manipulation. The difficulties that exist in establishing the distance over which these species may be effectively attracted were emphasized; it was suggested that not only the actual distance is important over which bark beetles may respond. Discrimination in the response behavior appears to be of equal importance for manipulations.

(3) Another problem in manipulation obviously exists when the synthetic attractants are being used in connection with insecticide or in autocidal techniques as this would affect a large segment of the predator, parasite and competitor populations.

INSECT-FUNGUS RELATIONSHIPS

Moderator: J. Chapman

Fifteen persons attended. At the start each stated briefly their interest in this field.

Introductory statements by the chairman included the following points. Both insects and fungi are large, biologically successful groups of organisms. They both utilize many terrestrial food niches and, consequently, are often found in the same habitat. Because fungi are saprophytic they often compete with insects for food supplies. Fungi might be considered as the "insects" of the plant world - or vice versa. Dispersion is a major problem for fungi and possibly for this reason many types of "cooperation" rather than competition have evolved between fungi and insects, which are motile. Relationships between these two groups include: fungi pathogenic for insects; fungi as food for insects; and a large series in which insects serve as carriers for fungi, in most cases where mutual benefits result from insect transport of the fungus. Ants, termites, Siricid wasps, and many beetles have evolved symbiotic relationships with fungi. In addition to the true ambrosia beetles there are "semi-ambrosia" beetles in which fungi enrich the insect's diet, and many instances of association between bark beetles and blue-stain fungi. Within the family Scolytidae there are now known to be 9 or 10 different locations on the body in which a specialized structure ("mycangium") carrying fungus is found. Mycangia were thought at first to be confined to the true ambrosia beetles but they have now been found in several bark beetles. The great variation in physical location of mycangia within one family of beetles indicates that these insects and certain fungi have long been associated in the tree or log environment. These forms of life are "pre-adapted" for a close association. The fungi involved are those representing the initial fungus invaders of dead or dying trees. Where highly evolved symbiosis between insects and fungi exist the possibility of antibiosis for other fungi should be kept in mind, with all its implications for possible control.

Members of the workshop currently working in this field reported on their studies. Stu Whitney (Calgary) has been rearing mountain pine beetles, starting from eggs externally sterilized. Beetles mature on an enriched phloem diet without the blue-stain fungus with which it is naturally related. This suggests that this relationship is not basically obligatory. However, yeasts and the blue-stain fungus probably assist establishment of the insect in trees. Ladd Livingston (Pullman) is studying the brown stain fungus associated with Scolytus ventralis attack on true firs. He hopes to clarify the relationship between the fungus and the beetle, whose biology is being studied intensively by Alan Berryman (Pullman). Clair Farris (Victoria) has been cooperating with Whitney in studying the relationship between blue-stain fungus and the mountain pine beetle. By micro-technique and culturing they have confirmed Farris' earlier record of a mycangium in the head (maxillae) of this beetle. Farris also is continuing to examine the Ips species of several of Hopping's groups for presence and location of mycangia. These structures have been found in two species of Ips so far.

It was agreed by those present that more "symbiosis" is needed between entomologists and pathologists in this field. There appear to be many problems in forest biology involving insects having some special relationship with fungi. Work on these problems must be in the borderline area between entomology and pathology. Present training tends to produce specialists in one field or the other, but here as elsewhere in biology there is need for a unitary approach. Until persons can specialize in both fields for study of some of these problems, good cooperation between entomologists and pathologists is needed.

ENVIRONMENTAL POLLUTION AND REGULATION OF INSECT POPULATIONS

Moderator: Ron Stark

The Workshop began by attempting to identify workers and institutions involved in pollution research. It became abundantly clear that there were few such studies related to the regulation of insect population. Studies reported included:

(1) U.S.F.S. Corvallis, Oregon. R. Tarrant. Reported on in the pollution panel. Studies on the effects of mass use of herbicides, fertilizers, etc., as well as pesticides. Restricted to forest and adjoining streams. Tied in with regional study on use of fertilizers but at present only limited studies on forest insect populations.

(2) U.S.F.S. Portland, Oregon. John Wear. A cooperative study on the use of remote sensing to detect visible effects of the use of forest fertilizers on forest stands. No forest entomology objectives written in as yet but John appreciates the valuable opportunity provided by such a study and will undoubtedly pursue this.

(3) U.S.F.S. Berkeley-Montana. The group from Berkeley, formerly headed by A. D. Moore has been studying the effects of Zectran on population levels of parasites and associated insects. Indications are that parasites are not adversely affected by volumes used.

(4) U.S. Forest Service. Montana. P. C. Johnson. No actual research yet but active socio-political groups and legal actions will undoubtedly precipitate research on the effects of the serious smog and air-pollution problems in Missoula - "the 6th dirtiest city in the U.S.".

(5) U.S.F.S. Colorado. M. Richmond. Effects of insecticides (Metacil, lammate, Sumathion) on song birds and small mammals. Will also involve soil and foliage residue analysis.

(6) Univ. of Wisconsin. D. Renland. Studies underway on status of DDT residues in forested areas and effects of air pollution on white pine.

(7) Univ. of California. Berkeley. A cooperative study on interrelationships of smog injury and bark beetle attack in ponderosa pine. Results indicate mountain pine beetle may be attracted to smog-injured trees, western pine beetle more prevalent in them indicating they are more susceptible.

(8) UCB. D. L. Dahlsten. Effect of pesticides on community stability in fir stands. Diversity of nocturnal lepidopterans to be used as an index. Establishment and success of mountain chickadee also under investigation.

(9) California, Lake Tahoe. R. C. Hall. Studies on direct kill and increase of flatheaded borers and possibly secondary bark beetles in trees where liquid sewage effluent sprayed.

(10) Canada. New Brunswick. M. Nielsen, R. MacDonald. Two studies reported, one to investigate the effects of Sumathion on the ecosystem in a balsam woolly aphid infestation, the other a long term study on the effects of almost annual spraying with DDT in a budworm area. The general comment on the latter was that there seemed to be little or no effect except in reduction of budworm.

Pollution is now considered to be the introduction of almost any foreign substance or by-product into the forest ecosystem. As far as was known there seemed to be few studies directed specifically to the effects of pollution other than pesticide on the regulation of insect population. Most studies are rather specific and generally in response to demonstrated damage by pollutants.

General observations included large increases in scale populations associated with sulfur fumes from pulp mills, sulfur dust in agricultural areas, dust raised by chickens in windbreaks (and presumably any animal such as grazing cattle which may raise a dust) and sprays to control mosquitoes and other insects.

European thought is that fertilizers decrease lepidopteran populations and increase sucking insect problems, backed up primarily by observation rather than data. J. Schenk observed that in windbreaks used heavily by chickens for roosting there seemed to be increase in bark beetle damage. D. Renland of Wisconsin reported a deleterious effect on red pine and an increase in sawfly population from abundant crow droppings - believed to cause an excess of nitrogen. D. Schmiege observed there was obviously "a relationship between excrement and increment."

It was the general conclusion that "pollution" in forests is going to increase. Increased use of fertilizers and herbicides as management tools will far exceed pesticide use. More and more people are moving into forested areas to live and for recreation, resulting in increased pollution with sewage, detergents, etc., of forest streams and of air with smoke from fireplaces and autos. Although fragmentary, we have enough knowledge to be forewarned that these developments will undoubtedly affect the forest ecosystem. As forest entomologists and ecologists we must keep alert to detect changes, investigate them and act upon our findings.

INSECT PHEROMONES AND ATTRACTANTS

Moderator: W. D. Bedard

This workshop was loosely structured. It contained everything from attractant showmanship to frank work discussions of the latest discoveries and theories. Only bark and ambrosia beetles were discussed in any detail. Much talk centered around what additional information is needed to survey for and control bark beetles, using attractants.

Scolytids have been shown to locate host over long distances. Exactly how this feat is accomplished is not known. Do they fly upwind for miles in response to odors, or do they happen by chance upon the odor trail near its source? Some variables encountered in an attempt to answer these questions are:

1) the patterns of the odor plume involved;
2) the concentrations of attractants within an odor plume;
3) the different response level from one beetle population to another;
4) the possibility of additional unknown chemical messengers being involved;
5) flight may be limited to undetermined areas by beetle preference for light intensity, temperature, wind speed, etc.;
6) repellency may be involved;
7) both lab and field methods of investigation have unforeseen limitations;
8) the host selection of each bark beetle species seems to differ from every other species.

Some people felt that it would be impossible to find exactly how individual beetles find their hosts and that the best approach was to measure the effective range of an attractant and forget attempts to trace the paths of individuals.

Ken Graham has found that Trypodendron lineatum is attracted by volatiles from sapwood which has undergone anerobic respiration. Henry Moeck presented convincing data that ethanol (a by-product of such anerobic respiration) is the major component in the primary attraction system of this ambrosia beetle. They feel that the breakdown of normal conduction in living trees or tree parts triggers the onset of anerobic conditions. This system could explain primary attraction in other species, especially secondary invaders.

Some possible relationships between response to attractants and internal changes, as regulated by hormones, were discussed.

ENVIRONMENTAL ENTRAINMENT OF INSECT ACTIVITY

Moderator: J. L. Saunders

The session began with a discussion and explanation of what constitutes environmental entrainment and then centered around the following topics:

1. Mechanisms of environmental entrainment
2. Importance of environmental entrainment
3. The role it should play in future work

Environmental entrainment was considered primarily as it associates with biological rhythms. Natural rhythms of daylight, temperature and lessor meteorological factors provide the exogenous signals needed for synchronization of internal functions of organisms which enable them to become entrained to the environment. This ability to respond to environmental signals has enabled insects to exploit the existing variety of ecological nitches through biological adaptation. It is probable that most, if not all, insect activity is influenced either directly or indirectly by previous entrainment phenomena.

There are two variables that contribute to a periodicity - exogenous components and endogenous components. Exogenous components are those that constitute the existing external environment, while the endogenous components comprise an insect's genetically controlled response to past events that influence its response to its current external environment. The external components are generally considered to show a diel fluctuation such as are observed with light intensity, temperature, humidity, wind velocity, etc. Endogenous considerations are rhythms, cycles and factors such as age and previous experience. There are three types of rhythm: a) fluctuation in the amplitude of a continuous process (metabolism), b) interval timers that control periodic occurrence of a discreet event (emergence, etc.), and c) continuously consulted clocks that involve time compensation systems for celestial navigation (bee navigation).

The importance of environmental entrainment in our work might be considered in two inseparable categories; first as an academic endeavor and second as it influences studies where insect activity is a factor. It is probable that results, or lack of results in some studies, are strongly influenced by failure to consider entrainment as it relates to capability of the test organism to perform under the existing conditions. Behavior studies should be especially susceptible to error where artificial conditions in the laboratory are at variance with endogenously controlled response. Bioassay results can be drastically effected by light and temperature conditions. In measuring any specific activity such as feeding, flight, copulation, ovaposition, etc., the results are usually much more dependable if manipulation and observation of the involved organisms is in accordance with the normal cycle of the phenomenon being observed.

It was generally agreed that most studies would be basically more sound if they could be planned and conducted in accordance with the principles of environmental entrainment.

INSECT PHOTOGRAPHY

Moderator: Wally Guy

Approximately 22 people attended the workshop, which began with a 29-minute slide talk; "High Magnification Macro Work." The following main topics were covered: proper equipment, lighting techniques, accessories, and an outline of the steps involved in shooting a photomacrograph. Following the talk, the group was invited to ask questions and discuss problems.

Representative of the many questions raised were: exposure problems, the best types of films, background treatments, and storage and handling of materials. Also involved were brief explanations of the law of reciprocity, resolution and difraction related to depth of field problems, and how the marked "f" number differed from the effective "f" number.

Mal Furniss proved quite helpful when the discussion turned to the problems of macro work in the field. Drawing on his considerable experience working under field conditions, he was able to give many good solutions to their problems. Mal felt that only the smaller cameras and light portable strobes were practical for the entomologist working in the field. He also stated that almost all of his photography was done with the camera hand=held.

The lack of good books on photomacrography was noted unhappily, and there was a short discussion of the few useful books that were available.

The rough draft of a handbook on photomacrography, supplied for the use of a short course, was passed around. The intention was to show actual samples of recommended background materials. However, the group showed considerable interest in obtaining copies. It had to be explained that the book was not edited for publication, and only a few copies had been made. Many stated that they would write to the station requesting a copy.

The genuine interest of the group was apparent when no one noticed that we had missed the coffee break! These people evidently feel the need of good photography in their work!

Since there was such a wide interest in photography, it might be advisable for the program committee to include photo workshops or even a full panel in future meetings.

THE HOST AND ITS RELATION TO SCOLYTID BIOLOGY

Moderator: Rob Reid

A non-scheduled informal meeting was held on the afternoon of March 12 to consider in broad terms the need for increased emphasis on host studies. Among those attending were persons responsible for direction of research programs. There was a general recognition that the host exerted considerable influence on the biology of the insect. There was less agreement on the level to which the entomologist should pursue studies on the host. Some felt it was not in the area of competence of the entomologically trained investigator. Others suggested the entomologist should receive training in plant physiology and anatomy sufficient to appreciate and investigate complex insect-plant interactions. The role of the University in providing that specialized training was discussed. The observation was made that Forest Entomology students were graduating with special and important training in biomathematics, genetics, or behavior etc., but not in the equally important area of insect-host interactions.

GADGET DISPLAY - M. M. Furniss

A method and technique section was introduced at the 12th annual meeting in Berkeley, 1961. It was revived this year, with the following contributors participating:

Mr. P. C. Johnson	Electronic area calculator for use with maps showing areas defoliated.
Dr. J. P. Vité	Colored chart for teaching recognition of insects infesting southern pines.
Mr. J. A. E. Knopf	Low cost system of installing camera on light aircraft for taking stereo photographs.
Dr. J. A. Chapman	Model of bark beetle eye and photo paper exposures taken through the eye; cellodin film replicas of beetle eyes;

	photos of smoke dispersal under various natural conditions.
Mr. R. I. Washburn	Vibrating scalpel for dissecting insects; light meter for measuring light intensity of small areas.
Dr. B. A. Butt	Codling moth sex attractant trap.
Mr. D. B. Cahill	Pocket slide rule for sequential sampling of bark beetles.

INSECT PHOTO SALON - M. M. Furniss

Slides and prints of insects, or related organisms, and damage were solicited for judging and awarding of ribbons. Judges were: Dr. Roger D. Akre, Dept. of Entomology, Washington State University; Prof. Roy A. Bell, Photographer, University of Idaho, and M. M. Furniss.

Only three people entered photographs for judging: Included were 6 color slides, 5 black and white prints and 10 color prints.

Winners were:

COLOR SLIDES

1.	R. F. Schmitz	Elaterid on log.
2.	R. F. Schmitz	Elaterid on log.
3.	R. F. Schmitz	Cerambycid on log.

BLACK AND WHITE PRINTS

1.	R. C. Beckwith	Large aspen tortrix larva.
2.	R. F. Schmitz	Ostomid stalking ips.
3.	R. C. Beckwith	Large aspen tortrix pupa.

COLOR PRINTS

1.)	Forest Research Lab.	
2.)	Winnipeg, Manitoba	Insect
3.)	(Forwarded by W. J. Turnock)	eggs

At the evening slide showing, Mr. Wally Guy, Master Photographer, Portland, Oregon rendered criticism of the photographs for the benefit of the 60 members present.

The contest photographs were supplemented by some 50 color slides of tropical insects (Akre) and browse plant insects (Furniss) and by prints made by Wally Guy. Additional photographs on display included examples of high risk pine trees (P. C. Johnson), photographs taken with a scanning electron microscope (H. S. Whitney, Calgary) and photo-micrographs of mycangia (S. H. Farris).

MINUTES OF FINAL BUSINESS MEETING

March 13, 1969

The Chairman called the meeting to order at 1:00 p.m. in the Convention Center, North Shore Motor Hotel, Coeur d'Alene, Idaho.

1. Minutes of the initial business meeting were adopted as read upon motion by Don Dahlsten, seconded by Al Hedlin.

2. Meeting sites
   a) 1970. Rick Johnsey discussed some of the possibilities of a meeting in Seattle.
      Dave McComb moved that we hold the 1970 meeting in Seattle area. Seconded by Ralph Hall. Carried.

   b) 1971. Following discussion of the invitations from Bob Stevens and Bob Stevenson, Al Berryman moved that the 1971 meeting be held in the Fort Collins area. Seconded by Bill McCambridge. Carried.

3. Rick Johnsey was appointed Program Chairman for the 1970 meeting.

4. Meeting time

   A suggestion by Alan Cameron that the meeting be held either at least a week earlier or two weeks later because of conflict with university examination periods led to discussion. It was pointed out that there are other considerations such as availability of meeting place, which enter into the decision on exact time but that the suggestion would be considered along with other factors in the future.

5. Meeting Theme

   Bohdan Maksymiuk suggested that the theme of the 1970 meeting be Research and Pest Control. Following discussion the theme was left to the discretion of the Program Chairman.

6. Mailing List for Notices of Meetings

   The mailing list was discussed in further detail with the following resulting:
   a) recommended that students not be included in the mailing list for notices but that academic institutions in the Conference area receive notices to be circulated among the students. Moved by Bob Stevenson. Seconded by Gerry Lanier. Carried.

   b) recommended that the next notices mailed include a paragraph indicating that if a registration fee has not been paid in the last two years the member's name will be dropped from the mailing list on the third year unless a fee of $5.00 is paid.

This will supply him with a copy of the Proceedings and keep his name on the mailing list for notices for a further two years. Moved by Galen Trostle. Seconded by Rick Johnsey. Carried.

7. Reports of Committees
   a) Nominating Committee: Phil Johnson presented the slate as follows:

      Councillors - 3 year term - Don Dahlsten
      1 year (completion of Chansler's term)
      - Bob Stevens

   Moved by Ralph Hall, seconded by Don Pierce that nominations close and that the secretary be instructed to cast a vote for the slate as presented. Carried.

   b) Committee on Common Names of Western Forest Insects
   Bob Stevenson, chairman, read the report. Moved by Bob Stevenson and seconded by Charles Sartwell that the report be accepted as presented. Carried.

   c) Ethical Practices Committee
   Chairman Alan Berryman pointed out that his office had been an onerous one and that he had a very difficult time in making his selection of the one to be honoured with the accoutrements of the office for the coming year. He discussed the outstanding contributions of many of the members. The point was made that the number of ladies among our membership is continuing to increase and that they in no small way, add to the difficulty of the office, because of their outstanding activities. He recommended that in future one of the ladies should act as co-chairman.
   For his noble efforts at this meeting Walter Cole was designated as the new chairman. Acceptance moved, seconded and carried.

8. Vote of Thanks
   Bohdan Maksymiuk moved, seconded by Bill Turnock that a vote of thanks be extended to the program committee. Chairman Dyer then also extended his appreciation for the work of that Committee.
   John Simeone and Don Renlund expressed their thanks for the opportunity of attending the meeting and invited the members to attend the Northeastern Forest Insect Work Conference and the Central International Forest Insect and Disease Work Conference, respectively. Mr. Chandler St. John, Supervisor, Coeur d'Alene National Forest invited members to visit the forest nursery.
   The meeting adjourned at 1:50 p.m. upon motion by Bob Stevens, seconded by Don Schmiege. Carried.

TREASURER'S REPORT

Balance on Hand April 4, 1968		$ 296.65
Received from Registration 1968	$1405.50	1702.15
Expenses for 1968 meeting	1341.40	360.75
Preparation of Proceedings	11.00	349.75
Balance on Hand March 10, 1969		349.75

REPORT OF COMMITTEE ON COMMON NAMES

OF WESTERN FOREST INSECTS

WESTERN FOREST INSECT WORK CONFERENCE

Although no formal acceptance by the Entomological Society of America of our submission of the following Dendroctonus beetles (submitted in October, 1968) has been received, we understand one of the 9 members of the E.S.A. committee has approved of our request.

Mountain pine beetle	D. ponderosae
Southern pine beetle	D. frontalis
Jeffrey pine beetle	D. jeffreyi
Western pine beetle	D. brevicomis
Spruce beetle	D. obesus
Mexican pine beetle	D. parallelocollis

No new requests for common names of western forest insects were received in 1968. One outstanding proposal regarding Puto sandini from 1966 is awaiting approval by the E.S.A. Apparently this request was misplaced during the transfer of files.

The conference chairman was advised to appoint David McComb of Portland and Harold Flake of Albuquerque to 3 year terms as replacements for Don Schmiege and Don Pierce whose terms expired at this meeting.

Respectfully submitted

Committee on Common Names of
Western Forest Insects

M. M. Furniss, Moscow, Idaho (1971)
J. A. Schenk, Moscow, Idaho (1971)
R. E. Stevenson, Calgary, Alberta (1970)
L. H. McMullen, Victoria, B. C. (1971)
D. D. Dahlsten, Berkeley, Calif. (1972)
D. C. Schmiege, Juneau, Alaska (1969)
D. A. Pierce, Washington, D. C. (1969)

MINUTES OF COMMON NAMES COMMITTEE MEETING

Room 352, NORTH SHORE INN, COEUR D'ALENE

March 11, 1969

Members in attendance: Les McMullen, Jack Schenk, Don Dahlsten, Bob Stevenson.

The chairman provided a statement on the status of the Dendroctonus proposals submitted in October 1968. Although no word has been received there is an indication that our submissions will be accepted. One additional name was added to the Dendroctonus group, D. parallelocollis "Mexican Pine Beetle".

No new requests for proposals of common names were received for 1969. However, much to the concern of the committee a request submitted in 1966 for Puto sandini, "Spruce mealy bug" had been overlooked in the shuffle of files during changes in the committee. At any rate, this unfortunate incident will be resolved soon.

The committee was alerted to the use of the common name "western spruce budworm" for Choristoneura occidentalis. General usage of this name would follow its acceptance by the W.F.I.W.C. Common Names Committee and the Entomological Society of America. Forest entomologists using this name have advised of the appropriate procedures to follow.

The conference chairman was advised to appoint two new members to replace Don Schmiege and Don Pierce whose 3 year terms expired at this meeting. The new candidates are Dave McComb of Portland and Harold Flake of Albuquerque.

No further business, meeting adjourned 10:30 p.m.

R. E. Stevenson
Chairman, (1970).

MINUTES OF EXECUTIVE COMMITTEE MEETING

March 9, 1969

The meeting was called to order by Chairman Dave Dyer at 8:40 p.m. at the North Shore Motor Hotel, Coeur d'Alene, Idaho.

Present were: Chairman: Dave Dyer
Secretary-Treasurer: Les McMullen
Councillors: Donn Cahill, Paul Lauterbach
Program Chairman and Past Chairman: Dick Washburn
Local Arrangements Chairman: Bob Denton

Minutes of the Executive Committee Meeting of March 3, 1968 were read and approved.

The Treasurer's report was submitted and approved.

Registration fees as set by the Program Committee and approved by the Chairman and Secretary were endorsed by the Executive Committee.

Possible 1970 and 1971 meeting places were discussed. Two potential invitations for 1970 were discussed and the decision, pending formal invitations, was left to the wishes of the Conference. There was a possibility of an invitation to the Denver-Fort Collins area for 1971.

The Chairman discussed his choice for the Nominating Committee.

Considerable discussion centered around the Conference mailing list and resulted in the following suggestions:

a) that students not be included in the mailing list for notices but that academic institutions in the Conference area receive notices to be distributed among the students.

b) that the next notice include a paragraph indicating that if a registration fee has not been paid for three years the name will be dropped from the mailing list unless a fee of $5.00 is paid for a copy of the proceedings.

Current program arrangements were discussed.

Upon a motion by Bob Denton the Chairman adjourned the meeting at 11:15 p.m.

CONSTITUTION

OF

WESTERN FOREST INSECT WORK CONFERENCE

Article I <u>Name</u>

The name of this organization shall be the Western Forest Insect Work Conference.

Article II <u>Objects</u>

The objects of this organization are (1) to advance the science and practice of forest entomology, (2) to provide a medium of exchange of professional thought, and (3) to serve as a clearing house for technical information on forest insect problems of the western United States and Canada.

Article III <u>Membership</u>

Membership in this organization shall consist of forest entomologists and others interested in the field of professional forest entomology. Official members shall be those who pay registration fees.

Article IV <u>Officers and Duties</u>

The officers of this organization shall be:

(1) A Chairman to act for a period of two meetings, whose duties shall be to call and preside at meetings and to provide leadership in carrying out other functions of this organization.

(2) An Immediate Past Chairman, who shall assume office immediately upon retiring as chairman without further election; whose duties shall be to fill the chair at any meeting in the absence of the chairman; to act until the election of a new chairman.

(3) A Secretary-Treasurer to act for a period of two meetings whose duties shall be to keep a record of membership, business transacted by the organization, funds collected and disbursed and to send out notices and reports. The Secretary-Treasurer is charged with responsibility of preparing the proceedings for the conference in which his term of office is terminated (amended Feb. 28, 1967, Las Vegas, Nevada).

(4) An executive committee of six members, consisting of chairman, immediate past chairman, secretary-treasurer, and three counsellors elected from the membership. Terms of office for the three counsellors shall be staggered and for a period of three meetings each. The duties of this Committee shall be to carry out actions authorized by the Conference; to authorize expenditures of funds; and to establish policies and procedures for the purpose of carrying out the functions of the organization. The Conference registration fee will be set by the local arrangements committee in consultation with the Secretary-Treasurer and Chairman (amended March 4, 1965, Denver, Colorado).

The officers shall be elected at the Annual Meeting. Their periods of office shall begin at the conclusion of the meeting of their election.

The chairman shall have the power to appoint members to fill vacancies on the Executive Committee occurring between meetings. The appointment to stand until the conclusion of the next general meeting.

It is the responsibility of a counsellor, should he be unable to attend an executive meeting, to appoint an alternate to attend the executive meeting and to advise the chairman in writing accordingly. The alternate shall have full voting privileges at the meeting to which he is designated.

Article V <u>Meetings</u>

The objectives of this organization may be reached by the holding of at least an annual conference and such other meetings as the Chairman, with the consent of the Executive Committee may call. The place and date of the annual shall be determined by the Executive Committee after considering any action or recommendation of the conference as a whole. The Secretary-Treasurer shall advise members of the date and place of meetings at least three months in advance.

Article VI <u>Proceedings</u>

A record of proceedings of conference shall be maintained and copies provided to members in such form as may be decided as appropriate and feasible by the Executive Committee.

Article VII <u>Amendments</u>

Amendments to the Constitution may be made by a two-thirds vote of the total conference membership attending any annual meeting.

Prepared by Richard Washburn
March 20, 1969.

MEMBERSHIP ROSTER

WESTERN FOREST INSECT WORK CONFERENCE

Note: Active members registered at the Conference In Coeur d' Alene, Idaho, March 10-13, 1968, are indicated by an asterisk.

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