An Interview with Ralph C. Hall

By

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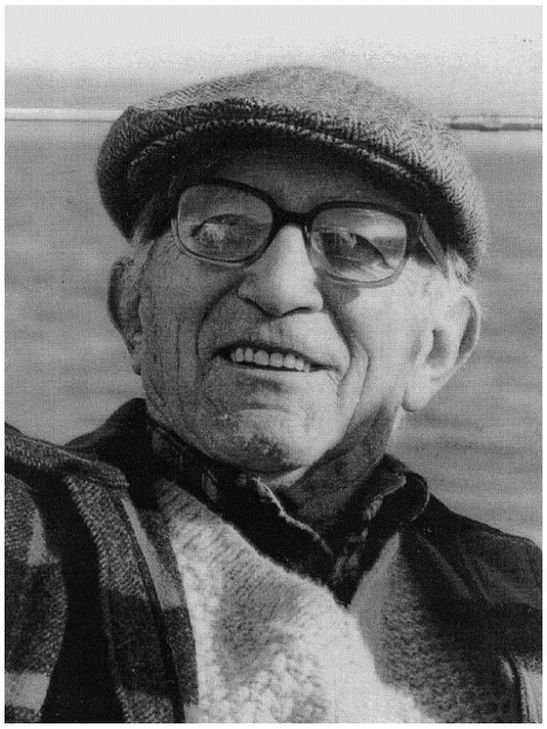
Editor's Note: I edited the transcripts of these interviews based on my association with Hall at the Berkeley Forest Insect Laboratory during 1950-1954 and my familiarity with western forest entomology and many of the people mentioned. I have added photos available to me as co-chairman of the history committee of the Western Forest Insect Work Conference, an organization of which he was a founder. Ralph was casual in his appearance and by his pleasant manner he forged strong cooperative ties with people of agencies and private companies engaged in forest management. He was a leader in the application of statistics to surveys of forest insect damage and biological studies. Ralph's interests were broad, involving professional societies, his community, and scouting. He was responsible for creation of the Forest History Society's oral interview project involving prominent forest entomologists in the 1970s of which this is a major one. I had the pleasure of being MC at a banquet in his honor at the 44th WFIWC in 1993. Ralph died three years later at age 96. (*American Entomologist* 42(2): 127-128 (1996))



Ralph Hall at age 88 in Scotland visiting his son, Jim, who was there on sabbatical from Oregon State University. 1987.

Session 1

Ralph C. Hall Lafayette, California November 16, 1974

Elwood R. Maunder: Ralph, where did your family come from and what was its background?

Ralph C. Hall: My family came from New York State. I was born May 7, 1899 in a little farming community called Briggs Street, near Ellenville in Ulster County. My dad was a tenant farmer, as was his dad. We moved around quite a bit and when I was four years old, we moved to Ridgefield, Connecticut, near Danbury, where we lived until I was eight years old, and then we moved back to Dairyland, New York. On our return to New York, my dad, younger brother, and I made the trip of about 150 miles in a lumber box wagon drawn by a team of horses. That trip made quite an impression on me, particularly the crossing of the Hudson River on the ferry.

ERM: How many brothers and sisters did you have?

RCH: I had four sisters and two brothers.

ERM: Where did you go to school?

RCH: My grammar school experience was all in one-room schools. I remember particularly one of my grammar school teachers, Ellen Terbush, who made a real impression on me. She just recently sent me a picture of the old Bell School at Dairyland, with our forty-student body. I attended the Ellenville High School for two years, and then we moved to Harriman, where I finished at Monroe High School. We made five major moves while I was growing up.

Upon graduation from high school I went right into the navy in 1918 in the First World War. I was assigned to the U*.S.S. Huntington,* a first class cruiser. We were responsible for convoying troopships across to Europe. We would start out with five to seven troopships and within about one hundred miles from the European shore, we would turn the troopships over to a fleet of French destroyers and then we would turn around and return to the States. This meant that we would see a lot of water en route. We had no real exciting experiences except that one of our destroyer escorts did pick up the survivors of a cargo ship that had been torpedoed.

ERM: Did your military experience have any effect on the career you chose afterwards?

RCH: No, as a second class seaman, my principal duty was standing watch and on wheel watch. I did get some experience in steering a big ship, having had that experience on three different ships. But my navy experience didn't do me much good after I got out late in 1919.

ERM: What did you do when you were mustered out?

RCH: It was too late to start college and I had to wait about a year. I had originally thought I would enter Cornell and take agriculture, but a high school classmate of mine was studying forestry at the New York State College of Forestry at Syracuse and was quite enthusiastic about it. I had also been introduced to forestry while spending a day in the field with a forester who visited our high school in Ellenville. I finally settled on forestry after spending about a year working for the Erie Railroad as a voucher clerk in New York City.

ERM: You had a lot of experience working on farms.

RCH: Yes, I did, and I also had experience working for the New York State Conservation Department in planting trees on the Harriman Estate near Arden. I remember one experience that I had when I was at Ellenville High School, where I got a little taste in forest entomology, collecting forest tent caterpillar egg masses in connection with a contest sponsored by the *Ellenville Journal.* I won that contest.

ERM: Do you feel this bent your interest in the direction of forest entomology, or was it just an incident?

RCH: That was just incidental. Actually, I didn't get interested in forest entomology until after I received my master's degree.

ERM: What college did you attend?

RCH: I entered the New York State College of Forestry at Syracuse in the fall of 1921 where I specialized in silviculture.

ERM: Who among your friends and professors at Syracuse do you remember most vividly?

RCH: My favorite professors included H. C. Belyea, R. R. Fenska, and Nelson Brown. I graduated in 1925 with a B.S. in forestry. During my junior year I got a summer job with the Hammond Lumber Company in the redwood region in Eureka, California, working on a survey crew developing a topographic map for the company holdings, and I decided to continue in forestry. My first job was teaching forestry at the sophomore summer camp of the New York State College of Forestry at

Cranberry Lake in the Adirondacks. Following that I took a job with the Northeastern Forest Experiment Station assisting Paul W. Stickel in his forest fire research at Cranberry Lake. I worked for the station until the fall of 1926 when I was offered a Bliss Scholarship at the Harvard Forest, where I specialized in silviculture under R. T. Fisher and graduated with my M.F. in 1927. I had passed the junior forester's exam and was offered a job in the West. At the same time Harvey H. J. MacAloney, who was doing research for the Bureau of Entomology on the white pine weevil on the Harvard Forest, offered me a summer job, which I accepted. This was a major turning point in my career, since my specialty up to this point had been silviculture.

ERM: Was this your first real involvement in entomology?

RCH: Yes, this was my first involvement in forest entomology and I really got quite interested in this specialty. I would like to point out that Harvey MacAloney was the person who made one of the biggest impressions on me so far as my career guidance was concerned.

Harvey was one of the early researchers in forest entomology, specializing in the white pine weevil. He later became assistant chief of the division of forest insect investigations in the Bureau of Entomology's Washington Office. I got very much interested in forest entomology while working for MacAloney, and decided to continue in this field. Harvey had his Ph.D. and his advice was, "If you're going to get very far in forest entomology, you really need an advanced degree." Harvey recommended Sam [Samuel A.] Graham at the University of Minnesota as being the outstanding teacher in the field, so I decided to go to Minnesota. In the meantime, Sam [Samuel T.] Dana, who had been director of the Northeastern Forest Experiment Station and for whom I had worked one year, was appointed dean of the newly formed School of Forestry and Conservation at the University of Michigan. Dana had hired Sam Graham to head up the forest entomology position at Michigan. Dana then offered me a junior instructorship at Michigan, which I accepted. He said to me, "Since Graham is coming to Ann Arbor, maybe you ought to come to Ann Arbor, too."

ERM: How did you finance your studies?

RCH: I pretty well worked my way through undergraduate work at Syracuse by acting as assistant chef at one of the fraternity houses for the first two years and then as night cashier at one of the downtown restaurants during the last two years. I was able to get by with a thousand-dollar loan in my senior year. During my master's degree work the Bliss Scholarship took care of most expenses, and for my doctoral, the instructorship took care of expenses, plus what I was able to earn during the summers.

ERM: You had worked for a year under Sam Dana at the Northeastern Forest Experiment Station at Amherst, Massachusetts.[1] You were therefore able to see one of the grand masters of forestry, Sam Dana, at work at an early time.

RCH: Yes, I worked for Dana in 1926, which was about three years after the station had been established. I feel that I was very fortunate in having the opportunity of working for Dana, both as an experiment station director and as the dean of the school at Michigan.

In my opinion, Sam Dana is one of the finest gentlemen that I have ever known. He was one of the most effective teachers that I have ever run across, as well as a very able administrator. He had a way of getting things done with his staff. I noticed this at the station level as well as at the university. He had the highest respect from his staff and students. Sam Dana, in my book, is one of the greatest.

My wife Dorothy and I have two sons who went back to Michigan for graduate work, Jim for his Ph.D. in fisheries, and John for his master's in landscape architecture. Dorothy and I saw the Danas frequently on our trips back to Michigan and when they came out West. We are very fond of both Ruth and Sam.

ERM: Tell me about your experience at Michigan and what it did to promote your work in this field.

RCH: I was very fortunate in having the opportunity to study under Sam Graham, as well as act as his assistant. I was his first doctoral candidate. Graham was a little different type of man than Sam Dana, but he was a very capable individual and an outstanding researcher. I found out by working as his assistant that he was a very fair man to work for. My title was junior instructor and I spent about half of my time as Graham's lab assistant. Since I was working half time, it took me four years to finish up work on my Ph.D. Although I specialized in forest entomology, I took a number of supporting courses in silviculture, game management, and statistics. I got quite interested in the

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[1] For further information, see U.S. Dept. of Agriculture, Forest Service. *A History of the Northeastern Forest Experiment Station, 1923-1973*, by Susan R. Schrepfer, Edwin H. Larson, and Elwood R. maunder. General Technical Report NE-7 (Upper Darby, Penn.: Forest Service, 1973.)

statistical field and Graham suggested that I should go to the University of Minnesota to take some work under J. Arthur Harris, who was a noted biometrician. It happened that Les [Leslie W.] Orr, who was teaching forest entomology at Minnesota, was interested in taking some further work under Graham, so Les and I swapped jobs for the academic year of 1929-1930.

ERM: Was Henry Schmitz the dean at that time?

RCH: Yes, I believe so.

ERM: Did you know Frank [H.] Kaufert?

RCH: Yes, very well. We were both graduate students and we roomed together at the same house. Frank was one of the really fine contacts that I made at Minnesota. I was really quite impressed with my year at Minnesota. There seemed to be a little more-friendly attitude than you would expect at a graduate school. I didn't get any degree at Minnesota; I just took some course work in statistics and entomology. I got my doctorate at the University of Michigan in 1931.

ERM: While at Michigan you had some classmates who have made considerable marks in the field of forestry, too.

RCH: Yes, of course, the outstanding person was Dick [Richard E.] McArdle, who ultimately became chief of the Forest Service.[2] Then there was Bob [Robert K.] Winters and Ivan H. Sims, both who made important contributions in the field of forestry, particularly Bob who specialized in foreign forestry. The four of us were the first doctoral candidates in the new School of Forestry and Conservation.

ERM: What was your relationship to Richard McArdle at that time, apart from the fact that you were both in the same school?

RCH: We were about the same age and we got along quite well together. Being a graduate student at that time I was permitted to drive my old Chevrolet. Dick did not have a car and I remember on one occasion loaning my car to him to take his girlfriend out. She later became his wife. Michigan had a strict rule against undergraduates driving a car. If caught, they were subject to being kicked out of school. One of my good friends, who later became the state forester of Florida, got in a jam by driving his girlfriend's car and was suspended for a year.

ERM: That wasn't [Clinton] Hux Coulter, was it?

RCH: You made the right guess. Another good friend of mine was Bill [W. C.] Branch, who followed me to California, in charge of state and private forestry in Region 5. The Branches, the McArdles, and the Halls had frequent steak roasts out at the cabin on Saginaw Lake.

ERM: Did you meet your wife, Dorothy, at Michigan?

RCH: Yes, she was teaching physical education at Michigan. We met through mutual friends back in Petersham, Massachusetts. We were married in the fall of 1930 and I received my Ph.D. in 1931.

ERM: Where did you go after you obtained your degree?

RCH: I had a choice of two jobs. One was teaching forest entomology back at Syracuse and the other was a job with the Bureau of Entomology in charge of a new central states regional forest insect laboratory, located at the Central States Forest Experiment Station, at Columbus, Ohio. I finally decided to take the Bureau job, and I think I made a wise choice because I don't think that I am cut out for teaching. I thought that research and administration would be more to my liking.

ERM: What was your first assignment in the station?

RCH: I was in charge of the central states regional forest insect laboratory, with responsibility for research and service on insect problems in the Central States. My major research problem was on the locust borer. Dr. Frank C. Craighead was my boss.

ERM: What was your relationship with Craighead?

RCH: I always had a real favorable relationship with Craighead. I felt that he was a strict disciplinarian but that he was a very fair person. I never had any particular problem with Craighead; I always highly

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[2] See also Richard E. McArdle. *An Interview with the Former Chief, U.S. Forest Service, 1952-1962*, conducted by Elwood R. Maunder (Santa Cruz, Calif.: Forest History Society, 1975.)

respected him. I know that MacAloney, particularly, had a real deep regard for Craighead. Dorothy and I got to know the Craigheads real well when I was temporarily assigned to the Washington Office in 1932 for **a** six-month detail. We a l s o got well acquainted with the Craighead twin boys, Frank and John, on some coon hunts along the Potomac.

ERM: Apart from the fact that he was a strict disciplinarian, what kind of a man was Craighead?

RCH: I'd say he was a rather quiet individual, not in any way a forceful person. But once he made up his mind about something, it was pretty well made up. If you were of a different opinion, it took a bit of selling to convince him.

ERM: He succeeded Andrew D. Hopkins, who was generally regarded as the father of forest entomology?

RCH: Yes, he did.

ERM: Hopkins was another very unusual man. Did you know him?

RCH: My only contact with Hopkins was meeting him once at a bug meeting. Hopkins was one of the most unusual scientists, when you consider the things he did in such a short space of time. His early publications on the western bark beetles are masterpieces. The remarkable thing about Hopkins's findings is that they have withstood the test of time. Miller and Keen's book on the western pine beetle contains forty-four references to Hopkins's published work of 1909, and with very few minor exceptions, a half century of research has confirmed Hopkins's conclusion.[3] Hopkins carried out his research on forest insects of the West in an interval of time that is unbelievable. He covered four states, California, Oregon, Washington, and Idaho in only a few months of field observations and collections. Then he went back to Washington, reviewed his data, and published his results [Hopkins 1899]. Just try to find a current scientist that does anything like that!

I think that very few people realize that Dr. Hopkins never attended college. He was truly a self-made man. The board of regents of the West Virginia University honored him with a degree of Doctor of Philosophy in 1893 in recognition of his successful mission to Germany in 1892 to bring back and introduce an important predator [*Thanasimus formicarius*] of the southern pine beetle. He apparently became interested in insects at age twelve. His first research on insects was a comprehensive study of an insect [*Agrilus ruficollis*] on raspberries on his farm. This led to his appointment as an entomologist with the West Virginia University Agriculture Experiment Station in 1890, followed a year later as state entomologist for West Virginia, and then in 1902 as the first chief of the Division of Forest Insect Investigations in the Bureau of Entomology. He was president of the American Association of Economic Entomologists in 1902 and president of the Entomological Society of Washington in 1907.

Among his other accomplishments, Hopkins developed the "host selection principle" which means that there is a very strong tendency for an insect to oviposit on the host from which it was reared. Another very important contribution to science was the useful empirical law developed by Hopkins at about the time of his retirement, which is known as the "Hopkins bioclimatic law." This law states; "Other conditions being equal, the variation in time of any periodic event (such as the emergence of insects or spring awakening of vegetation) in temperate North America occurring in the spring and early summer, is at the general rate of 4 days later to each degree of latitude northward, or 5 degrees of longitude eastward, or 400 feet of altitude upward. In late summer and fall, conditions are reversed." Hopkins was truly a very unusual, gifted person.

ERM: As mentioned earlier, one of the other pioneers of the West, H. E. Burke, wrote a memoir that is unpublished except in ditto form, in which he reported that Hopkins's trip to the West began April 9 and ended June 17, 1899.[4] Burke reported that later developments showed that Hopkins had uncovered and correctly interpreted most of the important forest insect problems of the western region.

RCH: That's correct. There are very few major insect problems that have shown up since his early publications.

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[3] Hopkins, *Preliminary Report of the Insect Enemies of Forests in the Northwest*; Miller and Keen, *Biology and Control of the Western Pine Beetle*.

[4] Burke, “My Recollections of the First Years in Forest Entomology.”

ERM: Apparently, forest entomology had a very long, difficult struggle getting established in this country, even more than forestry itself had. The Bureau of Entomology worked many years to get any real public support. It was far outstripped by the Forest Service at the same period of time.

RCH: Right.

ERM: You came to the Bureau in the 1930s, and even at that time, I gather, it was still very poorly funded.

RCH: Yes, I would say it was poorly funded. But considering the manpower that we had available, I think we made some rather significant accomplishments.

ERM: Would you single out some of the most important?

RCH: Yes, I can single out a couple of rather significant accomplishments. We have discussed Paul Keen's tree classification, which certainly was outstanding and then, the Salman-Bongberg risk rating system and the concept of sanitation salvage logging.[5] Both of these were outstanding research accomplishments in the field at that time. Both proved to be practical tools that were very useful in the management of ponderosa pine in the West, which significantly reduced serious losses caused by bark beetles through an indirect method of control. Prior to the development of Keen's and Salman's systems, we had to rely on direct methods of control of the destructive western pine beetle by the costly cut-peel-burn method which reduced insect populations but had no other effect on the environment. But, now we had a method whereby we could bug-proof our susceptible, eastside ponderosa pine areas, utilize the trees which were highly susceptible to insects, and at the same time remove any insect-infested trees, take them to the mill, utilize those and do it at a profit. The sanitation salvage method had the added advantage of leaving the residual stand in a thrifty condition with protective results lasting for more than ten years. Salman's method was tested by both industry and the Forest Service, found to be effective, and became standard management practice throughout the eastside ponderosa pine region. This, then, was a practical management tool that had developed out of Salman's research. Jack Bongberg was also involved in the risk rating system.

ERM: Salman was contemporary with Paul Keen. Their two systems appear to have been rivals of one another. How did that work out?

RCH: The two systems were basically different. Keen's tree classification was based on age, crown size, and dominance, while Salman's risk classification dealt entirely with tree health, in which he set up four classes, 1, 2, 3, and 4. Classes 1 and 2 were designated as low risk and 3 and 4 as high risk. There was also a basic difference in the amount of timber recommended for removal by the two systems. Under Keen's system about 40 percent of the stand would be removed while under the Salman system only about 15 percent of the stand would be logged. In my judgment, sanitation salvage was more generally accepted and used than was Keen's tree classification. Soon after sanitation salvage was recommended, it was field tested and adopted by three major lumber companies — McCloud River, Weyerhaeuser, and Collins Pine. In about 1940 the Forest Service in Region 5 adopted sanitation salvage treatment on all of its eastside pine stands as the first cycle cutting method. There was a regional difference in the adoption of the two systems. Region 6, for example, except for Weyerhaeuser, made more use of Keen's system. I don't recall any areas in Region 5 where Keen's system was used as a basis for bug-proofing a ponderosa pine stand.

ERM: I get the impression from reading H. E. Burke, and from talking with Paul Keen, that the Forest Service didn't always go along too heartily with the Bureau of Entomology in some of its projects. Do you know anything about that?

RCH: I understand that in the early days there was some friction between Hopkins and the Forest Service. Hopkins was quite a forceful person and he insisted that, although the Forest Service was authorized to do insect control, it be done under the supervision of the Bureau. He also insisted that studies of forest insect problems must be the responsibility of the Bureau. Burke reports an example to illustrate this point. In 1910, John Miller, who at that time was a Forest Service ranger, made a study for the Forest Service of a bark beetle outbreak near Yreka, California. When Hopkins learned about Miller's study, he immediately wanted to know what Miller was doing and why he was making examinations under the pretense of being a qualified entomologist and without the approval of the Bureau of Entomology. He requested that the Forest Service cease these goings-on until he could look into the matter. When Hopkins visited the area in April 1911 with Miller, he apparently was quite impressed with the job which Miller had done, and that same year Hopkins hired Miller. There was also some friction between Hopkins and the Forest Service concerning the validity of the Hopkins percentage principle, but this matter was resolved in

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[5] Salman and Bongberg, “Logging High Risk Trees to Control Insects in Pine Stands of Northeastern California.”

Hopkins's favor after Forest Service Chief Graves met with Hopkins to inspect a control project near Yreka. Graves reviewed the evidence and decided that Hopkins's percentage principle of the removal of from 50 to 75 percent of the infested trees in a control operation was effective. Hopkins' principle is stated:

> "As a rule, it is not only useless but unnecessary to attempt the complete extermination of. . . the beetles within a given forest. It is necessary, however, to so reduce and weaken their forces that they cannot continue an aggressive attack, thus leaving them to depend upon weakened and felled trees for their support and to occupy a defensive position against their natural enemies.
>
> It must be kept in mind that the beetles must occur in great numbers in order to be successful in their attack on healthy trees. If their number is reduced and kept below that required for killing trees, they can do no harm. Therefore in the case of a destructive outbreak it is necessary to destroy only from 50 to 75 per cent of the beetles in order to bring them under complete control."[6]

Graves then issued an official statement in support of Hopkins's principle, and I gather as a result the cooperation between the Bureau and the Forest Service improved. It is my impression that Hopkins mellowed a bit in later years.

When Craighead took over the Bureau, cooperative relationships greatly improved, and from my own experience I feel that the relationship between the Forest Service and the Bureau has been excellent.

ERM: The Bureau of Entomology had been set up on a very broad base to inquire into the whole realm of insect pests that afflict not only the forest, but shade trees, gardens, agriculture pests, et cetera. Later the name was changed to the Bureau of Entomology and Plant Quarantine. What provoked that changeover?

RCH: The name change occurred in 1934, as I recall. The plant quarantine functions of the government had previously been handled by a different bureau, but since the quarantine activities were aimed at keeping out both insects and disease, it seemed logical to make this consolidation of the bureaus of Entomology, of Plant Quarantine, and of Plant Industry. The new Bureau now had responsibilities for both insects and disease, whereas the old Bureau had responsibilities for insects only.

ERM: Do you have any insights as to why the forest entomology function was later shifted over to the Forest Service when the Bureau of Entomology and Plant Quarantine was wiped out?

RCH: I am not sure why they wiped out the Bureau, but I do know, that it was not due to any malfunctions in the Division of Forest Insect Investigations. As to why we were placed in the Forest Service: According to Keen, Ed Kotok was one of the principal supporters that we go into the forest experiment stations. This seemed to be a logical move since most of our laboratories were already located in the forest experiment stations on a cooperative basis. Another possibility at the time of the shift was that we might go into the Agricultural Research Service, but this plan was later abandoned.

ERM: Going back to when you began work in the Bureau in Ohio, how long were you there?

RCH: That lasted from 1931 to 1938 when, because of the growing importance of the forest entomology problems in the West, I was transferred to the Berkeley laboratory, and the central states laboratory was abandoned for several years. John Miller was head of the Berkeley laboratory, but I worked under the direct supervision of Dr. Ken Salman, who was Miller's assistant. I was assigned to head up the Hat Creek field laboratory, which had just been completed through the use of CCC funds. My main research problem was a study of the effect of climate on bark beetle outbreaks in northeastern California. I also had the added responsibility for service to landowners with insect problems in northern California. I remained at Hat Creek for fifteen years and was then transferred to Berkeley, as assistant division chief and placed in charge of regional surveys.

ERM: What were the main ideas that you determined from your research at Hat Creek? What affect has climate on the pine beetle?

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[6] U.S. Dept. of Agriculture, Bureau of Entomology, Barkbeetles of the Genus Dendroctonus, Bulletin 83 (Washington, D.C.: GPO, 1909).

RCH: First, we pretty well established that temperature has a direct effect on the number of generations of bark beetles produced, with the warmer the temperature the greater the number of generations. The more generations means greater annual loss from insects. In the Hat Creek area the average number of generations is about two, but in some years with warm springs and falls we recorded more than three. We also found that soil moisture during the growing forecast damage by Ips as early as June using spring period of the tree was very important. The years of abundant soil moisture, with resultant high phloem moisture, were the years of minimum losses. In contrast to this, periods of spring drought resulted in maximum losses. We were studying two principal bark beetles, the western pine beetle and the California five-spined engraver. The western pine beetle predominantly attacked and killed trees in poor health. In contrast, Ips would attack and kill young trees and top-kill older trees which appeared to be in good health, but only in years when spring precipitation was well below normal. These top-killed trees then became high risk and subject to attack and death from the western pine beetle. We found that we were able to accurately precipitation data.

ERM: Would you describe the conditions under which you and others worked during field assignments in the 1930s?

RCH: Generally speaking, if we were working out of a field laboratory, we lived in tents, as was the case in the early days at Hat Creek, until we constructed our log dorm in 1944. If we were on a bug survey that took us to various national forests, we would carry our tents with us and camp as close as possible to the area we were examining, and usually walk out to the job. But it was unthinkable, for example, to be working on the Modoc and to be staying at a hotel in Alturas. When we were working in the woods, we slept and ate in the woods.

Because funds for construction were lacking, staff of the Berkeley Forest Insect Lab built a bunkhouse in 1943 at Hat Creek Field Station, Lassen County, CA, with treated logs as an “experiment.” The stated purpose was to see how long bark would be retained. They are (l. to r.): R.C. Hall, “Shorty” Startt, G.R. Struble, J.W. Bongberg and P.C. Johnson.

ERM: When you say "we," what kind of groups are you referring to?

RCH: As a specific example, in 1938 which was the first year that I worked for the Bureau in the West, I had the responsibility of fall cruising our half-section regional plots on the Plumas, Lassen, Modoc, and Shasta national forests. One of my field assistants was Bill Hagenstein, who had just graduated from the University of Washington. My other field assistant was Cecil Badman, both of whom had been working for Phil Johnson on his hazard survey earlier in the season. We carried our tent and camping gear in a pickup. We were on the regional plot survey for about three months, and except for a week's stay in the Long-Bell logging camp at Tenant, where our meals were furnished, we camped out even during several snowstorms. Even if we had wanted to stay in a hotel, our $1.25 per diem would not have permitted. Bill Hagenstein felt that our per diem was pretty low and had a beef with Ken Salman on that subject. Ken, being an assistant to Miller, was getting a larger per diem. Ken's reply to Bill was, "Well, you know, Bill, I have to travel around a lot, and for example, [E. E.] Carter is coming out here next week and my per diem has to cover cocktails for him." Bill's reply was, "To hell with cocktails for Carter, all I am interested in is beans for Hagenstein." Bill didn't get an increase in his per diem or his beans either.

ERM: I imagine you had to cook for yourselves.

RCH: That's right, but on the 1938 survey **I** had the good fortune of having Bill Hagenstein for my cook, and they don't come any better. We bought all of our own provisions and had to take care of our own equipment. We were out in the field for weeks at a stretch, sometimes months. The 1938 survey lasted almost three months. That made it pretty hard on the family.

ERM: Your field surveys were usually done in the spring to summer months, I presume. Then you went back to your research station, assembled your data, and wrote up what you discovered. Was that the general pattern?

RCH: Yes, except that most of our surveys were made in the fall. We'd start out in the fall and go until the plots were finished. It was unthinkable, for example, to go back to Berkeley for the weekend. We just worked in the field until the job was finished. I think I see today a little different atmosphere and responsibility of the younger men.

ERM: Were those plots visited every year and checked out?

RCH: Yes, Paul Keen initiated the regional plot system in 1922 as part of the follow up check on the results of control on the Southern Oregon-Northern California Pine Beetle Control Project, which was the start of the system in Region 6. Ken Salman started the same system in Region 5 in 1930. These plots were cruised annually until we were transferred to the Forest Service in 1954. We had a continuous annual inventory of all trees killed on each plot. Records were carefully kept of just how many trees were killed each year and what insect killed them. In 1943 and 1944 Clarence Startt, my assistant at Hat Creek, and I were detailed to the Portland station to cruise the regional survey plots in Oregon and Washington. I feel that the dropping of these plots was really quite a serious loss. Today, we have a very inadequate basis for estimating annual losses caused by insects in the West.

ERM: Is there any indication that there will be a return to a systematic examination of plots?

RCH: As a result of research studies I conducted at Hat Creek in 1951, I designed a statewide cooperative sampling system, using a 2-1/2 acre plot as a unit. These were to be established, maintained, and cruised annually by various cooperative agencies; including industry, Forest Service, Bureau of Land Management, and California Division of Forestry. The Bureau established a number of these plots on Forest Service ownership in 1951 and 1952. Collins Pine Company, Soper-Wheeler Company, and the McCloud River Lumber Company joined in establishing plots on their ownership, but the whole system was abandoned when we were absorbed by the Forest Service in 1954.

ERM: Do you think perhaps that research in entomology has suffered because it came into the total picture of research in the Forest Service rather late? By the time forest entomologists joined the Forest Service, other areas of research had a much stronger hold on their research people. These had been under study much longer and were the more conventional areas of research for which funding might have already been established.

RCH: Following our takeover by the Forest Service, research in forest entomology remained at about the same level as it had in previous years, and there was little change of emphasis and effort until 1961 when the survey responsibility of the division was transferred to the region. At that point the division lost three men to the region, myself, George Downing, and Eric Jessen. In my opinion, the transfer of the survey responsibilities to the region was a very serious mistake. This move changed the whole concept of service to the small private landowner. The regional policy was and still is that the problems of industry now should be handled by the California Division of Forestry, and that the Forest Service survey people should confine their service efforts to federal agencies. The tradition of service established by Hopkins in 1902 and maintained for almost sixty years was destroyed. Previous to 1961 if a private landowner had a problem, he could call on a staff of some seven professional forest entomologists, but now he was limited to the services of one state man.

ERM: There seems to have been a long tradition of friendly relationships between the Bureau of Entomology and private landowners, particularly timberland owners. What was your own observation in that respect as you began your career in the Bureau, and later when you became part of the Forest Service?

RCH: I can give you a specific example of my work at the Hat Creek field laboratory. I was doing research work part of the time and service part of the time. It might be called an extension-type of service that is often offered. I felt that an important part of my responsibility was to help all the timberland owners in my sphere of influence, which covered all of northern California. Any time any of the timber owners in that area had problems they would contact me to ask for advice which I gave freely. George Struble was doing much the same thing in southern California. Hopkins started this service tradition and felt that this was a very important part of Bureau responsibilities. Even when

Hopkins had a small staff of three men, he was willing to assign two of these for surveys and control supervision on bark beetle problems in the West.

ERM: Certain problems relating to forest land management have appeared to be far more dramatic than forest insect damage. A forest fire makes a tremendous impression and sometimes has very catastrophic results in loss of property, sometimes whole towns. Fire arouses the public, whereas insect damage is a far less visible problem. Actually, insect damage may have a far more severe economic impact over time than fire.

RCH: That's correct, but the forest entomologists have been very poor salesmen in getting this picture across to the general public. Hopkins repeatedly pointed out that insect damage far exceeded that caused by fire. During the western pine beetle outbreak which resulted in the southern Oregon-northern California control project, we have good documentary evidence that for the period of that outbreak, which lasted for about ten years, losses from insects were about thirty times greater than from fire.

ERM: That was in the western pine area. Of course, fire doesn't take as much toll in that area as it does in certain other areas.

RCH: Yes, but if you take the statewide situation in California for the past fifty years, I think you will find that losses from insects have exceeded that by fire by about seven-fold. Visually, of course, a forest fire and a bug epidemic are quite different in their appearances. Except for some rather striking exceptions, such as the early western pine beetle epidemics, the Englemann spruce beetle outbreak in Colorado, the current mountain pine beetle epidemic in the Grand Teton and Yosemite national parks, and some of our defoliator problems, insect damage does not make much of an impression on the average forest visitor. It is only when you start to add up bug damage by the acre that the true picture emerges.

ERM: I have seen lodgepole pine stands with large areas wiped out leaving a ghost-forest situation.

RCH: Right, but how many average forest visitors have been impressed by that same picture? With the millions of visitors to the Tetons and Yellowstone during the current devastation to the lodgepole stands, how many wrote to their congressmen and senators and asked, "What is the government doing about this terrible bug problem?" Two years ago I camped in the Coulter campground on the Grand Tetons, where there was not a single, living, lodgepole pine tree over eight inches diameter, and where the National Park Service people were just letting nature take care of the situation. In the old days they would at least have tried to do something to control the infestation.

ERM: Aren't they following the same policy in that park now with regard to fire? Friends of mine who visited the Grand Tetons this summer said that they saw a forest fire which had been burning for months.

RCH: The Park's policy on control of fires is usually limited to the higher elevation rocky areas where the chance of rapid spread is minimal. I am sure if there had been a fire in the Coulter campground that a serious effort would have been made to control it. If such a fire had occurred in this tinder-dry, dead lodgepole pine, it might have wiped out hundreds of campers. I think the Park Service used poor judgment in not trying to control the mountain pine beetle. Ultimately, they've got to do something about those dead trees if they are going to continue to use the area for camping because of the serious hazard of falling dead limbs and trees. Why not cut and treat the trees while they still contain beetles?

ERM: What is the prospect that the bug population in those trees will spread out in all directions?

RCH: Of course, this is what often happens. But in this particular campground the beetles are going to run out of food. The bugs will have to either move or starve.

ERM: I suppose this is the result of the present ecological debate over what to do with the natural resources, whether to leave them to natural predators, lightning t fires and so forth, or to intensively manage them. Is that really what it is all about?

RCH: Yes, for a long time the Park Service had a rather definite policy of trying to control bugs in all national parks, with this policy originating as early as 1914 in Yosemite National Park. They have recently changed their control policy, and in some parks, such as Lassen, they have given up control entirely; while in Yosemite, they are doing a very limited amount of control of bark beetles in the valley floor and are doing nothing to try to control the destructive lodgepole needle-miner.

ERM: Back again to the 1930s when you were beginning your work, there were a lot of New Deal programs such as the Civilian Conservation Corps. What impact did that program have on the work you were doing?

RCH: By the time I came to California the CCC program was pretty well established. We had already established two field bases, one at Hat Creek and the other at Miami, as a result of CCC funding and labor assistance. The CCC program made possible a number of major direct control projects on national forests, Indian reservations, and national parks throughout the West.

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INTERVIEW II

Session 1

Ralph C. Hall
Puerto Vallarta, Mexico
March 5, 1975

Elwood R. Maunder: Ralph, I would like to begin with a consideration of your Ph.D. dissertation which was done at the University of Michigan and published as Bulletin Number 3 of the University of Michigan's School of Forestry and Conservation in 1933 under the title *Post Logging Decadence in Northern Hardwoods.* I assume that this was part and parcel of much of the work that you did on the bronze birch borer. Would you detail the work that was done for this thesis?

Ralph C. Hall: When I first started to pick a topic for a thesis, Sam Graham suggested a study of the bronze birch borer, which at that time was believed to be causing serious damage to residual stands of birch on hardwood cutover lands in the New England and Lake States.

ERM: Had this interest been stimulated by your earlier contacts with the Northeastern Forest Experiment Station at Amherst, Massachusetts?

RCH: I had observed some bronze birch borer damage in New England, but most of my work was assisting MacAloney on his study of the white pine weevil, and we ran into very little birch on that study.

ERM: What is a bronze birch borer and how wide is its range?

RCH: The bronze birch borer is a member of the *Buprestidae* which includes a group called the flatheaded borers. The larva resembles a horseshoe nail and the adult looks a little like a small boat. When the adults emerge from an infested tree that they have attacked and killed, they make a characteristic half-oval emergence hole. They are widely distributed over the United States, and in addition to their damage in the forests they are common pests- of planted birches.

ERM: Are you likely to find the bronze birch borer anywhere there are birches?

RCH: Their range pretty well coincides with the distribution of native birches.

ERM: How serious is this insect pest in comparison with others?

RCH: It is quite a serious pest around homes and in towns where they attack and kill ornamental birches. We assumed that they were doing the same type of damage in forested areas. But as we began to dig into this problem on cutover areas, we became convinced that their role in forested areas was secondary in that they could only kill birches damaged by some other environmental factor. We found that some birch trees on cutover areas were dying without any attack by the borer, which confirmed our suspicions that the borer role was secondary. As we looked into the problem more and more we became convinced that changes in the environment brought about as the result of cutting were the main contributing factors in the death of birches. We suspected that cutting practices, which removed about 80 percent of the original stand, would mean a drastic change in many of the environmental factors.

We then designed our study to measure soil moisture, soil and duff temperature, and even temperature of the tree itself. To measure tree temperature we installed thermocouples in one tree in the open and compared that with a tree in an uncut area and found highly significant differences in the cambium temperatures. We also found drastic differences in the duff temperatures on cutover areas compared to uncut stands. The maximum temperature of the duff on cutover areas reached one hundred and seventy-seven degrees, which meant that all of the feeding roots in that zone were killed. Other factors which differed significantly were the amount of direct sunlight, soil moisture and temperature, air temperature, relative humidity, wind movement, and evaporation. These changes in the environment were primarily responsible for the deterioration and sometimes actual death of the birches on cutover lands.

ERM: This would explain why the borer seemed to be more active in cutover areas.

RCH: Many of the birch trees weakened by changes in the environment were successfully attacked and killed, but the insects were successful mainly because they were attacking sick trees. We concluded that the bronze birch borer, under forest conditions, was a secondary insect. We also

found pathogens associated with the decadence problem, with *Fomes anosus*, a root rot frequently found. Among other things, we even dug up the root systems of sample trees and found that the feeding roots on cutover areas suffered severe damage. This study covering two years in the Lake States and another in New England was the basis for my Ph.D. thesis.

ERM: When you speak of "we" in making this study, who are you talking about?

RCH: I have been using "we" loosely. My first field assistant on the New England study was W. C. Branch, who later became assistant regional forester in Region 5. My younger brother, Raymond, helped me one summer. A third summer my assistants were two forest entomology students from Minnesota, L. H. Doty and J. C. Kopitke.

Among other things, we established a series of temporary sample plots in logging areas that had been cut under different intensities, ranging from a low of 30 percent to a high of 75 percent. We determined that the degree of cutting was very closely associated with the degree of damage, with the heaviest damage on areas with the highest percentage of timber removed.

ERM: Would you explain just what you did in setting up these plots?

RCH: The sample plots varied from a series of eleven permanent sample plots established in cooperation with the Northeastern Forest Experiment Station on the Cherry Mountain timber sale in the White Mountain National Forest in 1927. These were supplemented by a series of sixty-six tenth-acre sample plots in the northern Lake States established in 1928. Of these, forty-nine were in the Upper Peninsula of Michigan, six in northern Wisconsin, and eleven in north central Minnesota. These plots were reexamined in 1930. Factors studied on these plots included years since cutting, degree of damage by tree species since cutting, and the percent of basal area removed by logging.

ERM: Did the plot survey idea originate in America?

RCH: I am sure they had been using sample plots in European forestry before it was adopted here.

ERM: To what extent is forest entomology in this country in debt to Europe?

RCH: I don't think that there was a major impact from European experience. One particular outstanding forest entomologist in Europe was Dr. Ivan Tragardh, from Sweden, who made some contributions to forest entomology in the States by his visits here and through entomologists from the States visiting him. As early as 1892 Dr. Hopkins visited Germany to search for natural enemies that might aid in the control of the southern pine beetle, and he successfully introduced the p r e d a c e o u s *Clerus formicarius* Linn. In many respects our conditions are vastly different from those of Europe in both the types of insects involved and the greatly differing environmental conditions. For example, there are practically no primary forest insects in Europe, compared to our multiplicity of them. Perhaps Europe has benefited greatly from our experiences, particularly the colonial forest entomologists from Britain who have frequently visited the United States Bureau of Entomology to study methods of combating forest insect pests.

ERM: To what extent did your work on the bronze birch borer deal with a problem of economic importance?

RCH: In my bulletin I made some suggestions for forest management practices which I felt would result in reducing post-logging decadence. I specifically suggested that damage following logging in a birch forest could be greatly reduced by making a lighter initial cut, thereby minimizing some of the drastic changes in the environment.

ERM: In your bibliography to *Post Logging Decadence in Northern Hardwoods*, there is a reference to a study of the bronze birch borer by M. V. Slingerland at the Cornell University Agricultural Experiment Station near Bullock, published about 1906.

RCH: It was a rather significant historical document at that time.

ERM: You also refer to A. D. Hopkins's catalog of *Exhibits of Insect Enemies of Forests and Forest Products* at the Louisiana Purchase Exposition in St. Louis in 1904. [7]

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[7] U.S. Dept. of Agriculture, Bureau of Entomology, *Exhibits of Insect Enemies of Forests and Forest Products*, by A.D. Hopkins, Bulletin NO. 48 (Washington, D.C.: GPO, 1904.)

RCH: Yes, that was a list of the known forest insects at that particular time. He included the bronze birch borer in that list.

ERM: Apparently there was considerable awareness of the bronze birch borer prior to your in-depth study of it.

RCH: Yes, the life history, habits, and distribution were well documented prior to my contribution.

ERM: Your work gave you a real send-off into your chosen field. Are you aware of what impact your graduate research had relative to your employment in federal service?

RCH: I think that it may have had some impact. In 1930 I prepared a progress report summarizing much of the material which later went into my bulletin. I had forgotten about that report until I was working in the National Archives last winter and I ran across a copy with a letter from F. C. Craighead commenting on it and pointing out that he considered this to be a rather significant contribution. Since Craighead was the man I would be later working for, it may have had some impact?

ERM: What role did S. A. Graham have in this work?

RCH: Graham played a very important role in my work, acting as my supervisor and counselor in suggesting the type of approach to make, and also acting as chairman of my Ph.D. committee.

ERM: Approximately how many men were actually involved in forest entomology at that time?

RCH: Except for H. B. Pierson, who was working for the state of Maine, M. W. Blackman at the New York State College of Forestry, S. A. Graham at Michigan, Leslie W. Orr at the University of Minnesota, and W. J. Chamberlin at Oregon State College, practically all of the professional forest entomologists were working for the Bureau. My guess is that the total would be about thirty.

ERM: How did this compare with the number of research people in other branches of forestry at that time?

RCH: My guess is that for every research forest entomologist, there would be at least ten other research professionals in other branches of forestry.

ERM: Apparently your field had not attracted many specialists. In your view was there a reason for that?

RCH: I think that one of the main reasons was the limited opportunity for employment, with Bureau employment restricted almost exclusively to research.

ERM: The forestry schools were not pushing this field very hard?

RCH: At that time there were only four forest schools, Syracuse, Michigan, Oregon State, and Minnesota, that had a professional forest entomologist on their staff.

ERM: Who did they depend on, biologists?

RCH: Generally speaking there were very few forest schools placing much emphasis on forest entomology. Some schools, like California, offered an elective course for foresters taught by a general entomologist, in this case Van Dyke.

ERM: I notice that Samuel T. Dana wrote the forward to your thesis. Would you comment on Dana's interest in your work?

RCH: As with other graduate students, Dana had a deep * interest in my project. I kept him informed of my progress, and very much enjoyed his counseling.

ERM: Were other people interested in your research project?

RCH: Yes, one person in particular, Raphael Zon, director of the Lake States Forest Experiment Station, was interested in what we were trying to do and the possibilities of practical application of the results. I had several conferences with Zon reporting progress.

ERM: Both Dana and Zon played leading roles in the development of forestry research in this country. Zon had a reputation as a maverick in his day. How would you describe him?

RCH: I would say, in comparing him with Dana, that he was almost at the opposite end of the pole. Zon was very aggressive, outspoken, and in my opinion, very opinionated compared to Sam Dana who was a very quiet, unassuming, yet a very dedicated professional forester.

ERM: Did Zon's opinions relate more to policy than to research or did they perhaps include both?

RCH; I think perhaps a mixture of both; however my contacts with Zon were not sufficient for me to express a critical view.

ERM: Zon was a naturalized American citizen, but was born in Russia. Did he have a somewhat socialist point of view in his political theory, and do you feel that he pressed hard for socialist theory within the Forest Service?

RCH: I'm really not qualified to give an opinion on that subject.

ERM: Sam Dana, on the other hand, was a New Englander and probably more conservative in his political notions. What were your experiences working under him as an administrator's assistant in the northeastern station?

RCH: I think I covered some of those points earlier. I consider Sam Dana a very outstanding administrator. He did his job in a very quiet and yet very effective way. I had the privilege of being a junior instructor at Michigan and sitting in on some of his faculty meetings. I was greatly impressed with the manner in which he accomplished his administrative chores. He delegated authority quite widely and wisely. He was not an administrator who held the reins constantly in his own hands.

ERM: What were his accomplishments at the Northeastern Forest Experiment Station?

RCH: It is pretty difficult to measure the effectiveness of an administrator. It's an abstract kind of thing. I suppose one of the important ingredients is the inspiration which a man passes along to the men under his supervision. I feel that Dana had a dedicated staff in Marinus Westveld, Paul W. Stickel, Walter H. Meyer, and Perley Spaulding.

ERM: The station was only a year or two old when you came to it, and it was still struggling for adequate funds to carry on its job. Do you have any ideas or see any evidence of how Sam Dana managed to keep the station going, how he won public support?

RCH: I really don't have much of a background on which to base an opinion as to just how Dana got financing for the station and what his financial problems were. My general impression, as a field assistant, was that things were going pretty well there. I have something to add about Dana's early experience in the Forest Service. Back in 1908 Dana was a forest assistant on the Klamath National Forest during which time he came in contact with some of our serious bark beetle problems. He made a silvics study and a report on the Klamath area on the current infestation in which he reported, "A succession of favorable seasons might cause a great deal of damage."[8]

ERM: Your thesis opened the way for you to a new job with the Bureau of Entomology, at the Central States Forest Experiment Station at Columbus, Ohio.

RCH: Yes, that was in 1931, the year I received my Ph.D.

ERM: You got the job actually before your thesis was published in 1933?

RCH: That's correct. My thesis was not published until later, but since I had worked with the Bureau under MacAloney's supervision for one season, and as a field assistant for the Bureau two summers while I was doing graduate work, Craighead had some idea of my accomplishments. I had a choice of two jobs at the time of my graduation. One was a job at the New York State College of Forestry teaching forest entomology and the other job was at Columbus, Ohio heading up a new regional forest entomology laboratory.

ERM: The research job evidently held greater promise for you?

RCH: It did. I felt that I had more interest and probably greater ability in research than I would have had in teaching.

ERM: What was the nature of your first assignment at Columbus, Ohio?

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[8] H.E. Burke, “My Recollections of the First Years in Forest Entomology,” p. 18.

RCH: My first and primary assignment was research on the locust borer, a very important pest of black locust. Black locust had been widely planted on the spoil banks, left after strip coal mining in the central states, and were suffering severe damage in some areas by the locust borer. The locust borer seldom killed a tree, but the borer was an insect that worked inside the structure of a tree, and when heavily attacked, these trees were subject to serious wind breakage. Heavy borer attack very seriously affected the physical character of the wood for its primary use as posts,

ERM: Did black locust have any commercial value other than for fence posts?

RCH: Very little. Planted black locust had an indirect value in its ability to stabilize the soil, prevent erosion, and build up the nutrients in a soil.

ERM: How long did you work on the borer problem?

RCH: I worked from the spring of 1931 to April 1938 when I was transferred to Berkeley.

ERM: All those were years of the Depression. How did the Depression hit those involved in research and entomology?

RCH: It hit rather significantly. Shortly after [Franklin D.] Roosevelt was inaugurated and had declared the bank holiday; we took a cut in salary of one month's pay. The way the bank holiday hit me was rather interesting. I was on detail in Washington at the time and had received my monthly check on one Friday noon, and rushed down to the bank to get it deposited, which happened about an hour before the banks temporarily went out of business. I was then in Washington with no cash or credit for some time. I was very fortunate in having Craighead personally help me through this crisis. Ultimately, I recovered about fifteen cents on the dollar from the broken bank.

ERM: Was the Bureau able to maintain its entire force of men or did they have to let some go?

RCH: As I recall, we lost no permanent men, but we had rather severe cuts in our operating budget.

ERM: Did any of the emergency relief measures provide manpower for your work?

RCH: Not directly, so far as research assistance was concerned, but the Civilian Conservation Corps did make manpower available to the administrative branch of the Forest Service, Park Service, and Bureau of Indian Affairs, for insect control projects in Oregon, Washington, and California during that period.

ERM: You mean where they were cutting, peeling, and burning?

RCH: Right. The CCC men had an important role. I think that one of the most significant contributions so far as the Bureau was concerned were the facilities that were built, like the Hat Creek and Miami laboratories, with CCC funds.

ERM: Why do you suppose we resist so tenaciously putting that same idea to work today? Isn't it a tool that would not only assist research but might also relieve the terrible pressures of unemployment, especially among young people?

RCH: I can't understand why we are not doing the same thing today. I think one of the most significant results of the CCC program was that some of the young men who had gained experience there later became very prominent foresters in both industry and the federal service.

ERM: Do you know of any who went into entomology as a result of their experience?

RCH: Offhand I don't recall any. There were a number of CCC boys who later became leaders in industry and the Forest Service and later even became regional foresters. This was a real plus for the CCC program.

ERM; Why do you suppose the Society of American Foresters doesn't memorialize the Congress of the United States regarding this idea in the present situation? Would you mind carrying the question to the next council meeting of the Society of American Foresters on my behalf?

RCH: That's a good question; I will do that.

ERM: What other work did you do at Columbus besides that which you described?

RCH: I did some service work with extension foresters and state people but had very few requests for service from industry. My service work in the central states was rather minor compared to my work in California.

ERM: In other words, you were not answering questions dealing with problems individual landowners had with regard to insect pests.

RCH: Not nearly to the degree that I had in California, partly perhaps because the existence of the research station was rather unknown. I did some work on the Nantucket pine tip moth and published a paper on this insect. This insect is a rather important pest of planted pines throughout the southern portion of the central states, and although it is not a tree killer, it seriously retards height growth and tree form. Most of my territory was in the mixed hardwood type with few serious insect pests.

ERM: You had a tremendous area of the country to administer.

RCH: My territory included Ohio, Indiana. Illinois, Iowa, Kentucky, and part of Tennessee. As I said, I had two people working for me at Columbus who subsequently had considerable experience in the West. These included Bill Wilford who later was in charge of surveys and control in the Rocky Mountain Region, and W. H, Cummings who later became director of the Weyerhaeuser Centralia Research Center.

ERM: In 1938 there came a move to the West, is that right?

RCH: Right. There was pressure to do more research work in the West at that time. As a result, Craighead decided he would temporarily phase out the Columbus station and transfer me to the Berkeley station.

ERM: Was there little relationship between forest entomologists and pathologists who were working on such things as blister rust and chestnut blight?

RCH: Up to that point there had been very little coordination between the two branches. One exception was some cooperative work between H. J. MacAloney and Perley Spaulding in conducting a study of the effect of *Armillaria raellea*, a root rotting fungus, on cutover areas in New Hampshire. Today we are beginning to appreciate that insect and disease problems in the forests are often very closely integrated, and the entomologist and pathologist are finally getting together to jointly study many of our pest problems. We are also getting together at the conference level, and just recently we had a joint meeting of the Western Forest Insect Work Conference at Monterey, California.

ERM: When you were scheduled to transfer from Columbus to Berkeley, to what extent were your wishes and ambitions taken into account?

RCH: The individual had very little to say about such a situation. In other words, I was real unhappy about being transferred out of Columbus. I had just built a new home that I had lived in for less than six months. I was real happy with my work and associations at Columbus. I had contacted Craighead about the permanency of the Columbus post prior to my building my new home and had been assured that at that point the prospects of my staying on at Columbus looked favorable. I am not blaming Craighead for my move, since he had not anticipated the need to strengthen the work in the West. As I now look back on it, I don't know why I objected to being moved to the West.

ERM: Do you feel there were greater opportunities in the West at that time?

RCH: Well, yes I felt that although the locust borer problem was interesting, in the overall nationwide picture it was not too significant and didn't begin to compare with some of the bark beetle problems in the West. I feel in the long haul it's proved to be a good move, and I think I have really been contributing something rather significant to solving some important western insect problems,

ERM: When you came out West, where did you work?

RCH: I was assigned to the Berkeley Forest Insect Laboratory. My primary job was to take charge of the newly built forest insect field laboratory at Hat Creek, and to also start a study of the effect of climate on bark beetle damage. At the same time I was assigned the responsibility of surveys and control activities in northeastern California. In addition to my research at the lab, I was also responsible for service calls that came in from people that had insect problems,

ERM: How much of your time did those extension type services take up?

RCH: In some years a very significant portion of my time was spent on extension or service-connected responsibilities assisting lumber companies with their insect problems. Those responsibilities frequently significantly cut into the research I was doing.

ERM: When you would get inquiries of this kind, would you go to the scene to make an examination?

RCH: Normally, yes. It would depend a bit on the type of problem and whether the request for help could be handled by a phone response or by a letter. I never turned down a request for service.

ERM: Were your expenses usually paid for by those calling for service?

RCH: No, this was all part of our service responsibility. In one case involving several days of my time, a lumber company offered to pay for my services, but this didn't happen often. Of course, I turned the offer down because it was on official time. I don't know whether this service responsibility was written into the law that set up the Bureau of Entomology, but by tradition established by Hopkins and confirmed by Craighead, service to the public on insect problems was one of our important responsibilities.

ERM: Did it take priority over even your own research or special assignments?

RCH: Usually, yes. We were required to provide service to the general public, not only to the federal people but to any private individual who had problems.

ERM: That tradition seems very well rooted in the history of the Bureau of Entomology.

RCH: Yes. This tradition was maintained until about 1961 when the Forest Service regions took over surveys and control.

ERM: What were the first major projects that you were involved in at Hat Creek?

RCH: In the Hat Creek research project to study the effect of climate on bark beetles, weather stations were actually put out in the woods in what we call different hazard zones. Among other things that Dr. Salman developed, he also developed what he called a "hazard rating" where eastside pine stands were classified as to the probability of their being damaged by bark beetles. Originally four degrees of hazard were recognized, with hazard 1 being the least likely to suffer damage and hazard 4 being the most likely to suffer damage. Since no hazard 1 areas occurred within our study area, we restricted our study to hazards 2, 3, and 4. We established weather stations right out in the woods, where we set up hygrothermographs, maximum and minimum soil and air thermometers, a storage rain gauge, an anemometer to measure wind velocity, plus tree growth bands to measure diameter increment. These instruments served to measure air, soil, and duff temperature and moisture; wind velocity; precipitation; and all the factors that go to make up climate in these hazard zones.

ERM: Was this on a day-to-day basis?

RCH: Except for the Hat Creek master station which was maintained on a weekly basis year-round, the other three stations were maintained on a weekly basis from mid-April to mid-October for all factors except precipitation which was also measured monthly during the winter period.

ERM: Would that equipment measure soil moisture as well as air temperature?

RCH: Soil moisture was measured by collecting soil samples and oven drying them to determine their moisture content. Soil moisture fluctuates very little during the summer months, but does fluctuate greatly in late fall and early spring. Soil temperature is something that does fluctuate greatly during the summer, which we determined from readings from maximum-minimum thermometers installed at three different depths.

ERM: Did you also have other gadgetry that would measure the change in wind velocity, day-by-day and hour-by-hour?

RCH: We could determine the wind velocity hour-by-hour or day-by-day through the reading of our anemometer, but we were mainly interested in the total amount of wind for a given period, which was weekly when [the] readings were made. In addition to our weather records we also set up a twenty-acre sample plot in the near vicinity of each weather station where we kept records of the number of trees and their sizes which were killed by insects each year. Also, by risk rating each tree on the plot we were able to determine the risk of each tree killed. In addition we measured both diameter and height growth on selected trees on a weekly basis. We could then correlate the climatic changes with the changes that took place as far as diameter and height were concerned.

ERM: All of this research was fundamental to the development of what later became known as Salman's risk rating theory?

RCH: No, as a matter of fact Salman had already developed the risk system and the concept of hazard. What we were doing was testing it out to see how effective it might be.

ERM: How effective did you find it was?

RCH: We found his principle of risk to be basically sound, and it pretty well substantiated his theory. We found, for example, that the first trees to be killed on our sample plots were the ones which we had classed as risk 4, and a much higher percentage of the high risk trees were killed than were those which we had classified as low risk. We also found another interesting thing which was that the high risk trees were the trees which produced much higher populations of bark beetles per square foot of bark area. The low risk trees were occasionally attacked and killed, but their production of bark beetle populations was minimal. We also confirmed Salman's concept of hazard in that the high hazard areas were those where the climatic factors were unfavorable. That is, high hazard-areas were those with low precipitation, low soil moisture, high temperatures, and relatively low diameter and height growth.

ERM: How would you describe a risk 4 tree?

RCH: A risk 4 tree is a very sick tree compared to a risk 1 tree which is a very healthy tree. A risk 4 tree usually has a ragged crown with many bare spots, thin foliage, short needles, and often with active top-killing.

ERM: Is it difficult for the average forester to make value judgments?

RCH: No. Just a very little training, as little as one day, will equip a person to go out and mark risk with a high degree of accuracy. We've demonstrated that quite conclusively as the result of risk training schools that we have conducted, and found that our trainees received a high score when rating a series of test trees.

ERM: Is this now done at most forestry schools?

RCH: I am not sure, but it should be part of any course in forest management in the pine region.

ERM: Does this theory apply as well in other areas of the country and with other species, or is this something peculiar to the pine region?

RCH: The risk rating system is restricted to the eastside ponderosa pine type but is applicable to Jeffrey pine as well as ponderosa pine in that particular type. It does not apply to Westside ponderosa pine, and we are not just sure why. My theory is that it doesn't apply because we have a little different complex of insects. The main difference in species complex is the addition of the California five-spined engraver which is part of the Westside ecosystem. The engraver has a tendency to top-kill a lot of trees which appear to be in the very low risk class, which happens frequently during years of drought. When this top killing occurs, these trees then become highly susceptible to attack by the western pine beetle.

ERM: Has this risk theory been challenged by others in the field?

RCH: When Salman first proposed his system of sanitation salvage logging through the removal of risk 3 and 4 trees to bug-proof a stand, the main criticism was that this method of cutting would be too costly since only about 15 percent of the original stand would be logged. Elmer Hall of the McCloud River Lumber Company was willing to gamble, and they tested sanitation salvage on their Cayton tract in 1939 and found that the added cost was not prohibitive in view of the expected results. Weyerhaeuser tried it out in their Klamath Falls operation in 1940-1941 with equally good results. The Forest Service tried it out on the Modoc National Forest in 1940 and soon adopted sanitation salvage as standard logging practice in all of their eastside pine stands.

ERM: How would you compare the response of industry and of the Forest Service and other forestry groups, state and otherwise, to new research in your field?

RCH: This matter of dissemination of research information to the practicing forester is something that has bothered me for a long time. I am sure that the man in the woods is looking for better ways of doing his job. My feeling is that the researcher is oftentimes not able to convey his findings into loggers' language or understanding. Maybe what we need is more researchers like Salman who was able to take his revolutionary idea to a logger in the field and was able to sell his product. It is significant, I think, that Salman's sanitation salvage system was field tested and proven effective three years before his paper on the subject was published. Too many researchers publish their findings and then hope that somebody will read them and be impressed. It is sad to think of the amount of research that has been done, and results published, with so little of it applied in the field.

ERM: Aren't there specialists who translate within an agency or within a research group?

RCH: There are specialists but they don't appear to have hit on the right formula of getting results applied. When Clyde Walker was at the Pacific Southwest Forest and Range Experiment Station, he was very much concerned with this problem and made some rather significant contributions, but still there is not enough of it.

ERM: Is that an area that needs more effort and money spent in it?

RCH: Yes. I think there's a real opportunity there for the extension people. I also think the Society of American Foresters has an important stake in this problem. We are now seeing the Northern California Section of SAF teaming with Dr. Laacke, extension forester for California, who is spark-plugging a very effective program in continuing education through the use of a number of cooperative field schools where the researcher meets the practicing forester face to face in the field. These schools are held on a regional basis which reduces travel time of the participants. To date more than one thousand practicing foresters have been trained in various fields of forestry. I believe that this type of approach is one of the most effective so far.

ERM: Therein lies the key, perhaps, to obtaining larger support for further research.

RCH: Right. I think that the colleges and universities are in the same boat as the experiment stations in getting their knowledge out to the field for practical application. I happen to know of one university which was receiving a rather significant grant from a lumber company for research on forest insects. After about five years, the lumber company decided that they were not getting their money's worth in the way of practical results, so they terminated the grant. Here was an example of a lumber company that was trying to help out the researcher, and the researcher not being able to get the end product back to the lumberman. This is, I think, again the failing of the researcher.

ERM: Or perhaps, if not getting an end-product back to the user, at least a running stream of information about what he's doing on his research.

RCH: Right. To get back to this matter of service again, I think that the average Bureau man had been giving some pretty good service not only to industry but to private individuals and federal people, but in bringing some current research information to the man in the field. For example, for a long time the only method of control of the western pine beetle was to cut-peel-burn, but as soon as one of the researchers, Bob [Robert L.] Lyon at the Pacific Southwest Forest and Range Experiment Station, developed a chemical control through the use of lindane, this information was immediately passed on to the control agencies and the new method was put into practice. This is one example where the Bureau service people made a shortcut of research results.

ERM: What role did the CCC play at the Hat Creek field lab?

RCH: The CCC provided funds of eighteen hundred dollars plus labor to build a field laboratory and a garage building.

ERM: What would it cost to build those two structures today?

RCH: I would estimate at least eighteen thousand dollars.

ERM: Then it was a pretty important contribution.

RCH: Yes, a very important and very serviceable facility. We have since added an insectary, an experimental log dormitory which serves as a staff residence, tent platforms, and a cook shack.

ERM: Did you move your family up with you in 1938?

RCH: I moved my family up to Hat Creek, but since there were no dormitory facilities at that time, we rented a cabin at the nearby Hereford ranch for the summer period.

ERM: How many people were working at the Hat Creek field station?

RCH: In 1938 there were just two of us, myself and Charles Eaton, my assistant. Later when Eaton went into the service, I hired a local man Clarence (Shorty) Startt as my assistant. Startt had no experience in forest entomology, but he was quick to catch on and he developed into an outstanding practical forest entomologist. I also hired another local man, George Morton, during the winter months to service our weather stations. I also occasionally hired some local Indians to help out around the lab.

ERM: Was Eaton another entomologist?

Personnel of the Forest Insect Laboratory, University of California, Berkeley (front, 1. to r.): F. P. Keen, Edith E. Black, J. M. Miller, (back row): G. R. Struble, R. C. Hall, J. E. Patterson, P. C. Johnson. January 25, 1946. Photo no. 13,259-a. Missing is J. W. Bongberg, apparently still in U.S. Navy.

RCH: Yes, Eaton was another forest entomologist, a graduate of Syracuse. He replaced Paul Keen when Paul retired. Charlie started working with me on the climate study and from time to time other researchers from the Berkeley station, such as Patterson, Yuill, and Johnson, were assigned for short periods on special projects.

ERM: Would you care to describe the Burney-McCloud control project?

RCH: The actual control project was started in the spring of 1945, but I was involved in the planning phases of this project for about two years previously. This developed into a landmark project in the cooperative control of western forest insects.

I think I need to provide a little background to develop that story. My responsibility, among other things, as I pointed out earlier, was to carry on annual surveys of insect damage in northeastern California. In 1942 the forest insect situation in the Burney Basin was at a very low level. We estimated that we were losing an average of about fifty board-feet of timber per acre per year. In 1943 the infestation started an upward trend. We began to get Ips problems in much of our current cutover areas. Then in 1944 things really exploded. We continued to get massive top-killing by Ips, followed by the western pine beetle filling in the bases of the top-killed trees. This outbreak covered about four hundred thousand gross acres. The critical area was limited to a much smaller acreage than that. I became very much concerned about the problem. I indicated to Keen that I thought this was a job where we needed to consider a cooperative control project. As I remember, he agreed. This outbreak was occurring on a number of lumber company holdings, including the McCloud River, Scott, Burney, Red River, and Fruit Growers Supply. In addition, many ranch properties, the Burney Falls State Park, and a few parcels of Indian land were infested. Also, the Forest Service had widespread problems in the Burney and McCloud areas. We had problems scattered over all types of ownership. So now we had what I considered an opportunity to do something on a cooperative basis.

No one agency could do the total job. I had discussed the problem with many of the major landowners and pointed out the probable results if no control action was taken. In October 1944 I invited all the people involved or interested in the project to meet at the Hat Creek field laboratory, where we organized a field trip in which I pointed out and demonstrated what was happening, the insects involved, and type of damage. We had good representation from the owners involved including lumber companies, ranchers, the California Division of Parks, the U. S. Forest Service, Bureau of Indian Affairs, and non-owners including representation from the California Division of Forestry, the Western Pine Association, and Bureau of Entomology representatives. Upon our return to the lab for a conference, the general consensus was, "Yes, we need to do something about this problem." They asked for my recommendation which was that we should attempt to set this up as a cooperative project, with all parties participating. I recommended the control method should be the logging and utilization of as many infested trees as possible, and if logging was impossible that the remaining trees be treated by cut-peel-burn.

The California Division of Forestry was very much interested in cooperating. They had the authority to cooperate but they had no money. The Forest Service people said, "We'll do the work on Forest Service land, but we have neither the authority nor money to help out the private people." The private people said, "Well, we'd like to do our share, but we would also like to have a little help." The lumber companies said, "We will donate the infested stumpage." The Scott and Burney mills in

Burney and the McCloud River Lumber Company in McCloud all promised to do their utmost to log out the infested trees before the beetles emerged in the spring.

The weak link in the chain was the lack of funds to help out the private landowner. However, there was enough enthusiasm generated that a serious attempt was made to get the California legislature to appropriate an emergency fund of $10,000 to be administered by the California Division of Forestry to assist the small private landowners. J. Willcox Brown, forester for the Scott Lumber Company, acted as a spark plug to work on this problem. The new state forester, Swede [DeWitt] Nelson, and his deputy, Jim Mace from the Redding district, strongly supported the idea of emergency funds. Strong support was furnished by

Elmer Hall, logging superintendent of the McCloud River Lumber Company; Alvin Haynes, who was an influential local rancher; Ernie Kolbe, from Western Pine; and the local Hat Creek Grange. Through Will Brown primarily, they contacted Senator Oliver Carter, Senator George Biggar, and Assemblyman Paul Denny as well as Governor Earl Warren, and were successful in getting this emergency appropriation of $10,000 pushed through the California legislature. The legislature also authorized the Division of Forestry to assist the private landowner for 50 percent of the cost of control. The emergency appropriation was followed the next year by a regular biannual appropriation of $20,000 which became part of the regular California budget. The Burney-McCloud insect control project set the pattern for cooperative effort of sharing 50 percent of the cost of control on private land and stimulated interest in federal cost sharing which two years later culminated in the Forest Pest Control Act. This is a long-winded response to why I consider the Burney-McCloud project a landmark event in pest control.

ERM: What specifically was done in the project with the monies that were gathered from various sources?

RCH: The principal source of money was the $10,000 emergency fund from the State of California which was used by the California Division of Forestry to treat, by cut-peel-burn, those infested trees which could not be logged. The state established a twenty-man camp at Burney under the leadership of Melvin Pomponio manned by rangers and assistant rangers for training purposes. The state did a very effective job and we had excellent cooperation from everybody. The local ranchers contributed both manpower and horsepower to the project. We actually did some horse logging on the project.

ERM: Was anything done to burn the debris in which the Ips had bred?

RCH: The Ips infested material was burned along with the western pine beetle infested bark.

ERM: How about the green slash left after logging?

RCH: Prior to the Burney-McCloud project, the general rule had been to do nothing about this typo or Ips breeding material. Although we recognized the hazard of this material, I hesitated to recommend burning since this would have had to be done in late spring and early summer when fire danger was extreme. Instead, I recommended the lopping of all slash which would expose the stem to direct sunlight and greatly reduce the amount of favorable breeding material for Ips.

ERM: Couldn't this slash be burned earlier?

RCH: Logging in the Burney area usually started in May and June which coincided with the period of high fire hazard.

ERM: Is chemical spraying of the slash economically unfeasible?

RCH: Generally speaking, the cost is too high. I conducted some cooperative tests of chemical control of Ips with the Collins Pine, McCloud River, and Diamond Match companies and although effective it proved to be too costly, except under rather unusual circumstances.

ERM: Even with the high cost of stumpage these days?

RCH: My research was carried on when stumpage values were pretty low and perhaps today the cost benefit ratio might be much more favorable. Also, today we have a more effective chemical in 1indane.

ERM: I wonder if a part of the work of the logging crew could be a daily dousing of the slash after each tree is felled and bucked, i.e. if one member of the crew took a back canister and sprayed the rest of it. It might take a couple minutes per top to do.

RCH: To do the job effectively, you would almost need an additional man on your felling crew for that specific task since the unions would probably object to a feller doing chemical control.

ERM: What would you say about Patterson's work on tree injection?

RCH: Patterson had a project at Hat Creek injecting chemicals into standing trees to preserve them for poles and rustic buildings. His system was to construct a rubber collar around the base of a tree where a saw kerf had been made into the outer sapwood. The chemical was then poured into the rubber collar, and the tree absorbed the material and translocated it through the whole conductive system. Four preservative chemicals were used in this test-—copper sulphate, sodium arsenite, ammonium bifloride, and tetra-chlorophenate. These injected trees were then cut into about eight-foot log lengths and were used in the construction of the log dormitory at the Hat Creek lab. Each log section had an identifying number to indicate the chemical used. These logs have now been in place for more than thirty years and show little or no signs of deterioration. This log building served a dual purpose: it provided us with a dormitory and provided Patterson with a good sample test of the effectiveness of his treatment.

Craighead had an idea in the early days of injecting high risk trees and then storing them on the stump until they could be utilized, but this idea never was put into practice.

ERM: Couldn't that process also poison the bugs that are in the tree?

RCH: The problem of killing insects, such as the western pine beetle, that are in an infested tree is that the attacking beetles carry along a blue staining fungus which plugs up the conducting system, and the tree is unable to absorb the chemical.

In addition to Patterson's work with tree injection, he also acted as head carpenter in the construction of the log dorm. Practically everybody at the station, including Miller, pitched in to build this cabin.

ERM: How long ago was that?

RCH: We started the cabin in 1943 and finished it in 1944.

ERM: How has that knowledge been applied since then?

RCH: I don't know of any further application of Patterson's system. Unfortunately, nothing was ever published on this project, although Patterson did a thorough job of tracing the distribution of the preservative in each treated tree with accompanying photographs. His excellent progress report on the results, with numerous fine iIlustrations, is about an inch thick. This is a sad example of the results of a fine research project that is buried in the files and was never made available to the public.

ERM: Is Patterson still living?

RCH: No, he died July 31, 1962. After Patterson left the station, no one followed up on his project.

ERM: Isn't it the responsibility of the administrators of research agencies to minimize that kind of loss?

RCH: It certainly is. But the big problem is the rapid rate of turn-over at the director level. Another example of critical loss of research data happened when Duncan Dunning resigned. Dunning had been very active in collecting silvicultural research data at the Black's Mountain research field station, a branch of the California Forest and Range Experiment Station, where among other things, every tree over eleven inches d.b.h. had been measured and classified on ten thousand acres. Except for research on risk carried on by the Bureau, silvicultural research came to a virtual halt after Dunning left the station, and his wealth of knowledge was never made available to the public.

We seem to be always plowing new ground. So many times I see young researchers come up with what they consider to be a brand new idea that had been stated many years ago. DDT was discovered long before World War II. Somebody at that point just happened to remember something about it and took another look at it.

ERM: Shall we discuss the whole DDT issue?

RCH: The DDT issue is generally quite an emotional one and I will try to be as objective as possible. I have had considerable experience in the use of DDT to control a variety of forest insect pests. As early as 1944 I carried on experiments in the control of the western pine beetle and Ips at the Hat Creek lab, and found that it was very effective in controlling both of these pests when applied as a spray to the bark of ponderosa pine, both in preventing attack and in killing broods in infested portions of the tree. I also found that DDT was very lethal against the *predaceous clerid* group of bark beetle destroyers. I also supervised the aerial application of DDT to control a number of forest insects in eleven separate projects from 1952 through 1964.mentionedhese pests included the

lodgepole needle-miner, the pine reproduction weevil, the cone weevil in sugar pine, the Douglas-fir tussock moth, and the white fir sawfly. The dosage ranged from three quarters to a pound of DDT in a gallon of diesel oil applied at the rate of one gallon per acre. In the projects prior to 1954 we did our own monitoring to determine side effects. After that date we depended upon monitoring by various county, state, and federal agencies, including the county agricultural commissioner, the Department of Public Health, the California Department of Fish and Game, the federal Fish and Wildlife Service, the University of California, the California Division of Forestry, and the California Department of Entomology.

ERM: Would you describe the work and some of the results, first with the pine reproduction weevil in California?

RCH: The pine reproduction weevil is a serious pest problem in pine plantations, particularly those in brush fields where competition is usually extreme. Our first aerial application of DDT, using a fixed-wing Stearman spray plane, was against this pest in 1952 where we found it to be a very effective control agent. In most of our later tests we used a helicopter since this gave us much better control of the distribution of the spray. Our DDT spray projects, with one notable exception, gave satisfactory control of our target insect, with minimal side effects.

The one project where we failed to get satisfactory control was against the lodgepole needle-miner in Yosemite National Park. The spray plane we used was a B-18 converted bomber carrying six hundred gallons of spray, and because of the rugged terrain in the Tuolumne Meadows area it was necessary to fly about one thousand feet above the tree canopy. Although we applied one pound of DDT per acre, our spray deposit cards showed that only about seventeen-hundreds of a pound reached the ground. Our control effect was less than 20 percent compared to our normal control of more than 90 percent.

ERM: Was this the first aerial use of DDT?

RCH: This was the first aerial use of DDT in California. It had been used previously in the Pacific Northwest and in Canada.

ERM: What happened to the remainder of your spray?

RCH: I really don't know. We know that the bulk of the spray never reached our target. This is one project on which we goofed, and I will have to take some credit for that. We should have had a better research background for the project. We based our recommendations for this project on George Struble's "flit gun" application of DDT to the foliage. Rather than going for an eleven thousand-acre aerial project we should have had an intermediate step where we tested it on several hundred acres.

ERM: At the time did you have any awareness of possible negative results from the use of DDT?

RCH: In 1952 DDT was a relatively new tool in the control of forest pests, and very little monitoring work had been done on side effects. We discovered some negative effects in the Yosemite project. We found that our pilot was repeatedly making a turn over Tenaya Lake without cutting off his spray. As a result, wind action accumulated the DDT residue at the west end of the lake where the concentration was greater than four pounds of DDT per acre. This resulted in the killing of numerous suckers and a few fingerling trout in that area of the lake. We had examples where DDT had been sprayed over some stagnating pools of water containing fingerling trout that had no serious effects at all. We also observed some effects on frogs around Dog Lake.

ERM: DDT is a hot subject, of course. Did you on other occasions come to different conclusions about the use of DDT in pest control?

RCH: Yes. DDT is a hot subject but one that really needs clear thinking. I would say that in using DDT in the forest, we ended up with very minimal side effects. In our own monitoring, in addition to the Yosemite project, we found that when DDT is applied over a stream that it kills numerous aquatic insects, but we never found any effects on the fish in these streams. Except for the Yosemite job where we had no monitoring agency, in all subsequent major projects we had very complete monitoring by outside agencies which I mentioned before. In no DDT spray project did we ever have any indication of having killed a single fish, a single rabbit, a single deer, or a single cow. There is some controversy about what may have happened in a few cases to some birds. There is still a difference of opinion among scientists on this subject. Studies of mortality to aquatic insects caused by DDT have shown that this is a temporary effect and that within about a year the populations recover to normal levels. Studies with fish show no ill effect of eating aquatic insects killed by DDT.

ERM: I understand DDT has a long life. What about the long-term effects?

RCH: It depends on what you mean by long-term. One of the big advantages of DDT is its persistence in effectively killing the target insect. Our monitoring studies normally run for a minimum of two years, and in one case we have studies running for more than ten years by the University of California on the Modoc National Forest, following our 1965 tussock moth control project.

ERM: Do you feel that foresters and entomologists have been perhaps too little concerned about the impact of DDT?

RCH: I think both the foresters and entomologists have been very much concerned with the possibility of some side effects. I think that our monitoring effort by outside agencies demonstrates this concern. In our 1965 tussock moth DDT project on the Modoc we were concerned with what might be happening to the range cattle feeding within the spray area because the California Department of Fish and Game had found that DDT residue in deer had increased rather significantly. To check this effect, our monitoring team from the Department of Public Health analyzed fat samples taken from the range cattle just prior to spraying in the spring, immediately after spraying, the following fall, and the next spring one year after spraying. The results showed that prior to spraying, the samples contained one part DDT per million, which was un-explainable since no spraying with DDT had ever been done in that area. Immediately after spraying, the parts per million had jumped to twelve. The following fall the parts per million had dropped to seven and by the next spring, one year after spraying, the parts per million had dropped back to one. Nobody seems to know what twelve parts per million means for a range animal, but since it was temporary, it probably had little effect.

ERM: For those whose concerns are closely associated with forests, it's rather natural to seize any tool that will help solve infestation problems. And DDT has proven to be one of the most effective tools. It's not surprising that forest entomologists and others concerned would seize such a tool and perhaps be a little defensive about any attack on the use of it.

RCH: I think perhaps the forester has been oversensitive about some of the criticism leveled against the use of DDT in the forest. I know that I have been. It is interesting that some of this criticism has recently been proven to be erroneous, such as the flap about DDT as the cause for thin-shelled pelican eggs. Maybe I'm a little oversensitive, but it seems to me that some of our environmental research friends have drawn a pretty long bow in trying to tie down the effect of DDT on non-target organisms. In some cases, such as the control of the Douglas-fir tussock moth, the forester has only two options: one, to use DDT, the only known effective control agent; or two, to stand back, take no action, and let the insect destroy vast acreage of our fir forests. Of course, in some cases the forester has no choice since his hands may be tied by administration regulations from the Environmental Protection Agency, as happened in the recent tussock moth outbreak in Oregon and Washington. EPA refused to grant permission to use DDT the first year of the epidemic when three hundred thousand acres of fir forests were being heavily defoliated. With no control, the next year the infested area had nearly doubled and had expanded to include portions of Idaho. In the meantime millions" of board feet of timber and important unmerchantable growing stock had been destroyed. The landowners finally got permission to use DDT the following year and got very effective control in stopping the infestation.

ERM: You also have a whole new crop of scientists in various disciplines, some of them relatively new disciplines. The forester is being challenged to a great extent by a new breed that calls itself an environmental scientist and ecologist. I expect the same applies to the entomologist. In effect there is a war going on not only with the preservationists who are laymen but within the ranks of science itself. How do you as a scientist of many years' experience look upon this present situation?

RCH: First of all, I consider myself an ecologist—always have. I think Sam Graham was probably one of the world's most famous ecologists. A forest entomologist when faced with an insect problem must look at the whole environmental picture before choosing an action program. A fancy word now is ecosystem. I am bothered about some of the Johnny-come-lately so-called scientist approaches to a problem. In my opinion they fail to get enough real sound scientific evidence to support their point of view, often taking scientific evidence out of context and only using those segments which support their point of view. That wasn't the way Sam Graham taught me to evaluate a problem. A good example of the use of only partial scientific evidence is the controversy about bird damage in the Oregon-Washington tussock moth spray area.

ERM: They say it's having an effect on eagles and osprey.

RCH: Also in my opinion they are using rather unscientific data to back up their claims, such as finding a couple of dead birds in a few square feet and then converting this into an unbelievable number of dead birds per acre.

ERM: Aren't we in great danger of becoming more advocates than scientists?

RCH: I think an advocacy position is okay if it is based upon sound scientific evidence.

ERM: As individuals we may become too oriented to one single interest group, such as industry or conservation, and we begin to limit ourselves to the special needs and interests of that group because we have a close affinity with it. I think we can easily fall into the trap of becoming more advocate than scientist.

RCH: I think there is some danger in that possibility. We criticize others for their advocacy stand, and if we don't watch out, we may fall into the same trap.

ERM: I didn't mean to get off onto a philosophic toot here, but this is a matter of real concern and as a scientist, I'm sure you must have fretted no end about the subject.

RCH: Yes, I have. Of course, we haven't depended entirely on DDT for solving all of our insect problems; we use other substitutes such as Malathion or lindane if they are effective. For example, we tried Malathion on the Douglas-fir tussock moth and found that it was ineffective.

ERM: What do you think will be the long-range use of chemical agents of this order for insect control?

RCH: A lot of effort has gone into the job of finding a suitable substitute for DDT through the establishment of a special multidisciplinary unit at the Pacific Southwest Forest and Range Experiment Station, with millions of dollars already spent on this project. They were looking for a substitute insecticide with a short residual life and finally developed Zectran, which under laboratory tests appeared to offer promise of controlling the Douglas-fir tussock moth, but when field tested, proved to be ineffective partly because of its short residual life of only a few days. The sad story about Zectran is that after spending millions of dollars to develop it, the company decided to discontinue its manufacture for economic reasons.

ERM: What is the alternate to chemical control?

RCH: An ideal alternative is through cultural management practices such as sanitation salvage.

ERM: You had something to do with sanitation salvage in the southern California recreational forests.

RCH: Yes, I had a hand in introducing sanitation salvage in the recreational forests of southern California, particularly in the San Bernardino, Los Padres, and Cleveland national forests, although Bongberg started the first test on the Barton Flats area on the San Bernardino. We were faced with the problem of direct control of forest insects on these recreational areas, primarily in ponderosa and Jeffrey pines, in typically eastside pine type where we felt that sanitation salvage should be effective. When this method was first proposed, there was a lot of screaming that, "You can't cut timber in a recreation area; they will crucify you," which made some sense. But when this program was explained to the recreation people as to what we were trying to do and as to why we felt it had some promise of success, they said, "Let's try it on an experimental basis." Bongberg did much of the early missionary, work, and I followed up after he left the station. I had a selling job to do on the Los Padres in the Mt. Pinos area, where I had recommended sanitation salvage. At first the Santa Barbara Chapter of the Sierra Club objected strenuously to this proposal. However Jim [James L.] Aver ill, from the Forest Service regional office, and I invited members of the club to come out to the woods and see what type of tree we would propose to cut, which had been marked and risk rated. There were thirty-two Sierra Club members who attended this demonstration and at the end of the day we had convinced thirty of them that our program was acceptable.

Sanitation worked about as well in southern California as it had in the commercial forests of northern California. As part of our educational program we had labels on the logging trucks saying, "These are high-risk bug trees we are taking to the mill for lumber."

ERM: Do you think that concept will filter into the public mind on a wider scale throughout this country?

RCH: I think some of our problem with the general public is that we have failed to educate them on just why we are doing things which seem perfectly logical and reasonable to us.

ERM: Do you think that people in general, are too emotional about trees, especially people who have lived almost all of their lives in urban situations?

RCH: I expect that we are all emotional about trees to various degrees, particularly in the matter of cutting trees. Many people don't appreciate the need for managing a forest through proper cutting practices which remove dead and decadent trees, and if not so managed means a wasteful loss of a valuable timber resource. We have also failed to educate the public that a well-managed forest can be a beautiful forest.

Most people, of course, can see no beauty in a clear-cut block, which is perfectly understandable. But we have failed to convince them that this ugliness is temporary and that with proper treatment this clearcut block, after a few years, can again be a pleasing piece of scenery.

Session 2

Ralph C. Hall
March 6, 1975
Puerto Vallarta, Mexico

Elwood R. Maunder: Ralph, would you draw a few vignettes of some of the people you have known over the years at the research station in Berkeley? First, J. A. Beal.

Ralph C. Hall: Although he's listed as having been at the Berkeley station, Jim Beal was there for just a short time. He started working in the West at the Portland station for Paul Keen when it was established in June 1929. His principal project was the study of the effect of logging slash on the build-up of bark beetle problems. In 1935 Beal was assigned to Denver, where with Lynn Baumhofer as his assistant, he was in charge of the new regional laboratory to serve the Rocky Mountain Region. In 1939 he resigned from the Bureau and took a job teaching forest entomology at the Duke School of Forestry, and when Craighead retired in 1950, Beal took over the job as chief of the division of forest insect investigations at the Washington Office. Since his retirement from the Bureau he has been living in North Carolina.

ERM: Was he originally a southerner?

RCH: He was born in Arkansas.

ERM: Do you remember anything in particular about Beal as an entomologist or a person?

RCH: Dr. Beal is a very capable entomologist with a wide variety of experience nationwide. He is very pleasant, a little bit on the quiet side with a good sense of humor, and he is a very cooperative individual. He got along well with people. He demonstrated a high degree of administrative ability in his position as chief of the Bureau. A few years after he was appointed chief in 1950, the financial support of the division increased more than tenfold. During that same period he was able to get some nice forest insect laboratories built around the country and in Alaska.

ERM: What do you recall about W. D. Bedard, Sr.?

RCH: Bedard was assigned to the Berkeley station from Portland where he had been working for Paul Keen in a study of the root system of ponderosa pines in cooperation with the Weyerhaeuser Company near Bly, Oregon. Prior to his transfer to Portland, he had been working for Jim Evenden at the Coeur d'Alene laboratory. Although his name was W. D. Bedard, he was really Charlie Bedard, which was the name he wanted to go by. My wife taught his wife physical education at the University of Michigan. Charlie was at Michigan studying under Sam Graham the year I graduated. We were good pals. He was quite an aggressive individual and a real good scientific worker. He passed away shortly after he came down to Berkeley while he was still actively working for the station. His son W. D. Bedard, Jr. is now working for the Berkeley station on pheromone studies of forest insects.

ERM: What about J. W. Bongberg?

RCH: Jack Bongberg became quite famous as part of the team of Salman-Bongberg in the development of risk rating and sanitation salvage logging. Following Salman's resignation, Jack took over the surveys and control project at the Berkeley station. In 1952 Jack was transferred to Albuquerque to establish a new field station to serve the Southwest. Later he was called to the Washington Office of the Forest Service to replace Jack [John M.] Whiteside in charge of the Division of Forest Pest Control at the national level. Jack is now retired and living in Florida. He is a rather outgoing individual, a good writer and talker, who gets along well with people.

ERM: Do you remember H. E. Burke?

RCH: I didn't know Burke very well. He had retired before I came to Berkeley. I met him occasionally, but my association with Burke was rather limited.

ERM: Did you know R. Z. Callaham?

RCH: Although Bob Callaham started out in forest entomology, after a few years he switched to genetics. His first assignment was assisting Paul Keen in checking his ten-acre sample plots. Later he carried on some host resistance research at the Black's Mountain Experimental Forest. Callaham

is a very aggressive person and somewhat opinionated, but a very capable researcher and administrator. He has progressed quite rapidly in the Forest Service and is now director of the Pacific Southwest Forest & Range Experiment Station. At one time he was in charge of their Division of Forest Insect and Disease Research in the Washington office.

ERM: Callaham has been very supportive of research in the history of forest entomology and urged the Forest Service to participate in the sponsorship of this series of interviews.

Did Don DeLeon work in defoliators?

RCH: Not specifically on defoliators. His first work with the Bureau was about 1927, when he worked with Person on the Cascadel project, and later in 1937 with Beal on the parasites and predators of the Black Hills beetle. One of his major contributions at the Berkeley station was to list forest insects which attack redwood, together with their life history and habits. Following his service in World War II, Don was transferred to Beltsville. He has since passed away. He was a very serious researcher and a very quiet unassuming person.

ERM: Apparently there is something about redwood that doesn't taste good to bugs. I presume that part of the reason redwood grows to such a tremendous age is because it escapes the ravages of insects.

RCH: Yes, we have no primary bark beetles which attack redwood. A few secondary insects work in twigs sometimes but cause no serious damage.

ERM: You knew George Downing of course.

RCH: George worked for me when I was in charge of surveys and control and shifted to the region when they took over these responsibilities. He worked for a time in Alaska and is now in charge of surveys and control in the Rocky Mountain Region. George is a real careful worker with a very pleasing personality and a fine sense of humor.

ERM: What do you recall about C. B. Eaton?

RCH: C. B. Eaton was quite a dominant figure. Charlie's first assignment at Berkeley was acting as my assistant in our climate studies at Hat Creek. Following his stint in the service he was transferred to Beltsville where he worked with Yuill and [Robert C] Heller in developing a technique for the application of chemicals from the air. When Keen retired, Eaton replaced him as chief of the division of forest insect investigations at the Berkeley station in 1952, about the time we were absorbed by the Forest Service. I had the unique experience of having Charlie work for me and then later of working for him. Charlie was a very serious individual and he definitely had ideas of his own. He had quite a temper but a very poor sense of humor. Charlie and I didn't always see eye to eye. He was very strong for preparing a very detailed work plan for any contemplated project and then adhering rigidly to that plan. My philosophy was to make a plan, but then when the project got under way to have the option of modifying the plan if things did not turn out as expected. A case in point was a work plan we had prepared for the control of the lodgepole needle-miner which called for the application of twenty gallons per acre of a Malathion mixture in diesel, applied from a helicopter. The spray was applied at the time of optimum moth flight, and the helicopter would make about four or five passes over a specific area in order to get the required twenty gallons to the acre coverage. I was supervising the project and was assisted by Bob [Robert E.] Stevens. I observed that after the first pass of the helicopter, the moths just came raining down like mad. On the second pass more moths came down, but on the third pass practically no moths came down, as was the case in the fourth and fifth pass. I felt that we were over-dosing and said, "Charlie, why don't we try half-dosage?" He replied, “No, we can't do it because the plan calls for twenty gallons of spray." However, on the next similar test one year later we cut the dosage to ten gallons per acre.

Eaton was all business; I can never recall him telling a joke. He passed away in 1964 while he was still chief of the division.

ERM: Were you rivals for the directorship of the station at Berkeley?

RCH: No, I was not a serious contender, and in any event I was not interested in that amount of administrative work.

ERM: Was there any rivalry for the post?

RCH: I don't recall that there was. Some people at the station thought that Bongberg might get it, but I don't know if Jack was considered.

ERM: When a man in a position like that comes to retirement age, is there any tendency for internal groups to line up behind one or another candidate for the job?

RCH: This type of politics apparently occurred when Hopkins retired, where Keen, Miller, Snyder, and others were apparently trying to prevent Craighead from being appointed to replace Hopkins.

ERM: I guess that people in a science of this order would be more oriented to being scientists than they would to being administrators. They might eschew administrative responsibilities to pursue their own research interest. But there are attractions, like power and a larger salary, that go with administrative jobs. To what extent did those inducements enter the picture as you observed it over the years?

RCH: I can't think of any examples where any of my associates were obviously looking for that kind of power.

ERM: Was there more or less of it in the Bureau than in the Forest Service?

RCH: In my opinion there would be less of it in the Bureau because it was a smaller agency. I don't know what part Keen played in the selection of his replacement.

ERM: What about M. M. Furniss?

RCH: Mal Furniss is a younger brother of R. L. Furniss. He was hired by Paul Keen in 1950 for insect surveys and control supervision. He wrote the annual insect conditions report and took over Jack Bongberg's study of bark beetle risk at Blacks Mountain Experimental Forest when Jack transferred to Albuquerque. He worked for me on surveys during 1952-1954. Part of our responsibilities each fall was surveying insect damage from the air on all major timberland in California, requiring about a hundred hours of flying, often in turbulent air. Mal usually got airsick. He was more interested in research and when an opportunity came up for a transfer to the Intermountain Station, he took it. Mal has turned into an outstanding researcher and has made some major contributions to our knowledge of the Douglas fir beetle and insects of wildland shrubs of importance to wildlife. He is now located in Boise, Idaho [Retired at Moscow, ID 1982. Biography contained in his Founders Award address, Proceedings 50th Western Forest Insect Work Conference, Breckenridge, CO. September 16, 1999].

ERM: What about his brother Bob?

RCH: Bob Furniss left the Berkeley station before I arrived so I had very little contact with him. While at Berkeley, he did a lot of basic work on the life history and habits of the western pine beetle, particularly in working out the number of generations in different climatic zones. At the Portland station he concentrated on insect problems in Douglas-fir and is considered a world authority on that subject. He replaced Paul Keen as head of the Portland lab when Keen transferred to Berkeley and since his retirement has revised Bulletin 273**,** Insect Enemies of Western Forests, which should be reprinted in the near future. Bob has also been active in the Pacific Northwest Pest Action Council.

ERM: How well did you know A. Gordon?

RCH: Aaron Gordon was only a casual acquaintance. He was a biochemist assigned to the Bass Lake center, working on tree injection experiments aimed at controlling the fir engraver and mountain pine beetle. However, his research yielded negative results.

ERM: Did you know R. N. Jeffrey?

RCH: I knew Jeffrey only by reputation. George Struble reports that Jeffrey worked under Hubert Person's direction at the Buck Creek field base on the Modoc National Forest. He cooperated with Nick Mirov in his study of the oleo-resin constituents of pines.

ERM: Did you know J. W. Johnson?

RCH: J. W. Johnson worked at Hackamore and Black's Mountain from 1938 to about 1942. During that period he studied and reported on a wide variety of insects, including scale insects, the California flatheaded borer, top-killing in pines, root studies, the biology of the turpentine beetle, and the trapping of the western pine beetle in saw logs. He was a prodigious worker and a talented writer.

ERM: What can you say about P. C. Johnson?

RCH: Phil Johnson was another dominant figure in the Berkeley station. One of Phil's main responsibilities was making a hazard inventory of some four million acres of eastside ponderosa pine stands. At the start he did this under Salman's direction but later took over complete responsibility after Salman resigned. Salman had developed the procedure for determining hazard by sampling past volume of timber killed by insects combined with the percentage of the stand in high risk. Johnson set up his field quarters right out in the woods, with a crew of about ten field men plus a cook. Johnson also analyzed his field data and prepared maps denoting the hazard zones for all of northeastern California, Phil was a meticulous researcher and an excellent photographer.

ERM: Was this a further sophistication of Salman's theories?

RCH: Yes, and as it turned out, the areas which Johnson mapped as being high hazard were those areas where epidemics later developed. This also served to underline the correctness of Salman's theory. These hazard zone maps also served as guides for the land manager in which to direct his logging operations. In 1945 Phil was transferred to the Coeur d'Alene forest insect lab, which in 1953 became the Coeur d'Alene Research Center and Johnson was appointed Acting Leader when J. C. Evenden retired in 1954. On January 31, 1955 the Center was moved to Missoula, Montana, where it became the Missoula Forest Insect Lab with Johnson as leader until June 1, 1961 when it was abolished by Forest Service reorganization.

ERM: Now there's Paul Keen.

RCH: I worked for F. Paul Keen starting about 1942 when he came down to replace Miller. Paul is a man intensely dedicated to his work. He is a very serious individual and a very precise-researcher. Not being a married man while he was working for the Bureau, Paul failed to appreciate the importance of a man getting home to see his family occasionally. Bongberg tells the story that two weeks after he was married in 1947, Paul took him on a field trip to Oregon to check his ten-acre plots, and that it was nearly nine months later before he returned. He said, "Not really nine months, but it seemed that long." Paul didn't get married until after he retired. He was really married to his job. Paul has a real fine reputation in the West, particularly with industry people. Without any question, he is considered the dean of forest entomology in the West. Paul received many honors including the U. S. Department of Agriculture Superior Service Award in 1947, the Western Forestry and Conservation Award in 1953, the American Forestry Association Award in 1954, and was also named a Fellow of the Society of American Foresters.

ERM: Can you draw from memory some anecdote of your work together in the field or around the station?

RCH: Paul and I worked very closely together to drum up support for" the federal Forest Pest Control Act of 1947. I felt that Paul was quite conservative in his estimate of how much money we needed for carrying on surveys and control activities. In 1944 Paul and I arranged a meeting with some strong supporters of the program—Elmer Hall from McCloud and R. R. McCartney from Weyerhaeuser, We met at McCloud with Congressman Clair Engle to fill him in on what we needed in the way of funding for the implementation * of the act. Engle specifically wanted to know how much money he should ask for. As I recall, after Paul had built up a story of the devastating damage caused by forest insects, Clair asked Paul, "How much money do you think we should ask for annually?" Paul replied, "Oh, about $50,000." Clair's response was, "Hell, here you build up this big story of how important this problem is and then you say you can cure it for $50,000 a year. You are just wasting my time asking me to support that kind of a program. If $50,000 is all you need, I'm really not interested in going to Congress to ask for that kind of money. Now, if it's $500,000, then I'm interested." I feel that Paul has been rather conservative in his estimate of needs for both research and control. His reasoning sometimes is, "Well, we don't have enough skilled manpower to do the job if we got additional money," rather than saying, "If we get additional money, we'll go out and develop additional manpower."

ERM: Did the director of the station determine what annual budgets should be? How did the decision-making process within a research station function relative to annual budgets?

RCH: It was the responsibility of the division chief to establish a level of budgeting which he felt would meet his annual needs, and if increases were recommended, it was his responsibility to defend such increases. I know that when Miller was head of the station, he was out to promote more funds each year. I'm not sure whether or not Paul asked for additional funds each year.

ERM: In budget making, was the man at the top guided to a considerable extent by the recommendations of his staff for each of their various projects?

RCH: I would think that the station leader would rely rather strongly on the recommendations of his staff. I know that Miller relied very heavily on Salman's estimates of annual needs.

ERM: Can contemporary people in the field learn anything from historical experience in that area?

RCH: Support for forest insect research has been a long time coming. I have always felt that we were very seriously under-budgeted in proportion to the importance of the problems we were trying to solve. We are just now reaching a plateau where we are beginning to get real national recognition of our problems and real financial support to attempt to solve them.

ERM: To what extent do you think it has been due to the failure of entomologists in positions of administrative responsibility to ask for larger amounts?

RCH: In the overall I think we have been very poor salesmen. We have had too few leaders like John Miller, who proved to be a very good salesman and worked hard at developing financial support at the state level from such agencies as the California State Chamber of Commerce. I think, too, that we have suffered at the national level. My impression is that Craighead was a little weak in soliciting funds from Congress; I feel that the chore of developing public support for additional funds was one that he disliked. The financial picture improved greatly after Beal took over as chief.

ERM: Do you think you would have received more funding had you been more explicit and demanding of support?

RCH: I think perhaps we would. Our program for adequate political support was a long time in coming.

ERM: To what extent has your budget been restricted by the fact that it goes through the hands of others in the Forest Service who review it and relate it to what's being asked by other divisions of the same bureau?

RCH: I think maybe this is pretty important. If you are part of a big organization like the Forest Service, your unit may be a rather small part of the whole. But your unit has to share in some substantial overhead charges. This did not apply when we were a division in the Bureau. As a part of the Forest Service we had to help support all the administrative staff of the station including the director, his assistant and clerical staff, the chief of the division together with all the fringe agencies such as the statistician, the editor, the station photographer, the librarian, and other supporting personnel.

ERM: Of course, all of those people dealt specifically with certain of your own needs, did they not?

RCH: Except for editorial assistance, we pretty much had our own library with access to the main and specialty libraries on the campus of the University of California. The plus in respect to the Station library was not very great.

ERM: You don't think that the library at the station was of tremendous advantage to you?

RCH: Not in forest insect research.

ERM: Let's return to your recollections of individuals. How do you recall the work of R. L. Lyon?

RCH: Bob Lyon is heading up the Insecticide Evaluation of Forest Insects Unit, whose research mission is to seek safe, selective, non-persistent chemicals and formulations for control of forest insect pests and to develop methods of aerial application that will provide maximum target insect suppression with minimal adverse effects on the environment. Prior to this assignment Lyon was working on the chemical control of insect pests at the station and did quite a bit of work with lindane trying to protect trees from attack by Ips and the western pine beetle.

ERM: What was the role of H. L. McKenzie?

RCH: Howard McKenzie was not a forest entomologist. He was a scale specialist, working primarily on a group of scales called *Matsuccoccus* which rarely cause the death of a tree but do cause considerable deterioration in pine trees. Prior to coming with the Bureau he was working at the California Department of Entomology at Sacramento. McKenzie and I carried on a control project against the black pine leaf scale in the Crestline area in southern California. Although we were successful in controlling this scale by applying a chemical in an oil spray, the cost proved to be pretty high and was not recommended for control in commercial timber areas. Howard and I also did some cooperative work in the Hat Creek area where he artificially infested pine trees with *Matsuccoccus* to determine what effect they would have on deterioration of pine.

ERM: Here is another great one: J. M. Miller.

RCH: John Miller was really outstanding individual. When you first met John, you might have the impression that he was a little aloof or cool, but down deep he was a really sincere and lovable

person. He was the kind of leader who really inspired the people working under him. I will always remember a week-long pack trip that John and I made into the Chiquita Basin in the winter to service one of our storage rain gauges. This was ray first experience on a western cow pony. John was very patient in teaching an eastern greenhorn the intricacies of steering the beast. A few times when I was pulling on the reins instead of pushing, I got tangled up with the pack horse I was trying to lead. John was an ideal companion to be without in the deep woods away from civilization.

Of course, you hear lots of stories about Miller's absentmindedness — losing glasses and the like. I think Paul pointed out that somebody had to go around the field after him to pick up Miller's field glasses, things of this sort. I have one interesting example of his forgetfulness. One time we were traveling along; John was driving and both of us were smoking pipes. Occasionally, John would ask me for a match and, as I recall, I had my matches in small boxes. We went along a little farther and John said, "How about another match?" I replied, “I thought I just gave you a match." I gave him another box of matches. He struck the match on the box, lit his pipe, then threw the box of matches out the window.

ERM: He must have been a legend in his own time.

RCH: He was. John was not a forest entomologist at the start. His first job with the government was as a forest ranger working for the Forest Service. I believe his first experience in forest entomology came when he was assigned the job of checking up on a bark beetle outbreak on the Klamath National Forest. Miller made a survey of the damage and reported back to the regional forester on his findings. At that time, according to Burke, when Hopkins heard about it, he said, “What's Miller doing up there making a survey of forest insect damage? He is not an entomologist." [Miller received a B.S. in Biology at Stanford, 1908]. His studies included a course in entomology taught by Prof. R. W. Doane Hopkins came out to review the situation and found that Miller had apparently done a very creditable job in assessing the bug damage. As a result of that, Hopkins apparently thought, “Miller is somebody that I want in my organization." Shortly thereafter Miller was transferred from the Forest Service to the Bureau. John Miller did a lot of very interesting research. Of course, he was the senior author of U. S. Department of Agriculture Miscellaneous Publication Number 800, *Biology and Control of the Western Pine Beetle.* He made a major contribution to that. The tendency seems to be, though, when people refer to that book, to call it Keen's book, although Miller's input into it was very significant.

ERM: Miller acquired his credentials in the field rather than in school?

RCH: Yes, he acquired his knowledge of forest entomology through practical experience in the field. He was the kind of an individual who could gain very easily by experience.

ERM: How important is it for a man in the field of entomology to have an academic degree?

RCH: In Miller and Hopkins's era the lack of an academic degree was no problem. Unfortunately today, we seem to have the attitude that a person must have a doctorate in order to be a good researcher. I think this is a definite fallacy. It seems to me that a lot can be gained through practical experience and that too many of our young Ph.D. researchers come to the job without any previous field experience. I can cite some specific cases where a man who does not have a Ph.D. is doing outstanding research. I feel that we place too much emphasis on the label.

ERM: Now let's turn to Nicholas T. Mirov.[9]

RCH: Nick Mirov was a Russian immigrant from Siberia, who in 1928 became an American citizen. Mirov's first work with the Bureau was under Hubert Person at the Buck Creek field base on the Modoc. His project was to undertake the extraction, distillation, and analysis of resins from pine trees to determine their effect on bark beetle attack. Nick later transferred to the experiment station where he carried on research on heptane, a distillate of Jeffrey pine.

ERM: What is heptane's value?

RCH: Heptane is a colorless, inflammable liquid hydrocarbon of the methane series used as a solvent and in the determination of the octane number of motor fuels. Nick was a very outstanding researcher with a very pleasing personality. He got along well with everybody. He was awarded the Barrington Moore Memorial award by the Society of American Foresters for outstanding achievement in forestry research. Nick retired and is now living in Sacramento.

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[9] For further information on Nicholas T. Mirov, see *Eddy Tree Breeding Station: Institute of Forest Genetics*, interviews conducted by Lois C. Stone (Berkeley, Calif.: University of California and Forest History Society, 1974.)

ERM: How about A. D. Moore?

RCH: Art Moore first came to work for the station as a survey man taking care of survey problems in southern California. He later accepted a position at the University of California as the first professional forest entomologist to teach forest entomology on the staff of the Division of Entomology and Parasitology. Later, when the insecticide evaluation of forest insects project was established at the station in 1964, Moore was placed in charge. He retired a few years ago and is living in Idaho.

ERM: You knew J. E. Patterson.

RCH: John Patterson was another very good friend and associate of mine. Pat was certainly a self-made man. He never had any technical education. He came to the station in the early days from his ranch near Ashland, Oregon. He was deeply involved in the southern Oregon-northern California control project and while on that project made an in-depth study of the Pandora moth outbreak on the Klamath Indian Reservation. One of his important research projects was the injection of chemicals into the sap stream of ponderosa pine, which I mentioned yesterday in connection with our log building at Hat Creek, where Pat was also head carpenter. I think that it is rather significant of Patterson's ability that Paul Keen picked him as his assistant to run the station. He was an outstanding photographer, and Miller hired Patterson originally for his photographic abilities.

ERM: You mentioned several men here who were outstanding photographers. Where are their pictures now?

RCH: Most of them are in Berkeley in our old forest entomology library. Unfortunately, something happened to some of the pictures in the late fifties when somebody in our Washington Office decided that they wanted many of our original negatives, many of which were never returned. I believe that this happened after we became part of the experiment station. We have tried repeatedly to get these returned but with no success.

ERM: Lee [Leland J.] Prater in Washington may be helpful in locating those old missing negatives. Since his retirement from the photographic section of the Forest Service, he has been working under the sponsorship of the Forest Service and the National Archives to catalogue and computerize information on hundreds of thousands of old negatives and photographs.

RCH: That is a good suggestion. We had the original negatives of all the photographs used in Burke's memoirs, but many of these are no longer in our Berkeley files.

To get back to Patterson, he was an outstanding amateur ornithologist, among other things. His collection of birds' eggs should be in a museum.

ERM: Where do they exist?

RCH: I'm not sure what happened to them when Patterson passed away. In addition to his technical expertise, Patterson had a rather outstanding administrative ability which he demonstrated as assistant chief of the Berkeley lab.

ERM: I gather that you give him very high marks in the history of the station?

RCH: Yes, I would give Pat very high marks. I would say Patterson would fit right in that slot next to Miller.

ERM: How do you rate the work of H. L. Person?

RCH: Hubert Person was a very important staff member of Miller's crew in the early days. His first important task was in charge of the Cascadel Basin field base on the Sierra National Forest in 1927, and later in charge of a similar field base at Buck Creek on the Modoc National Forest. Person did some early basic research on the western pine beetle's tree selection habits as well as its flight habits. He was the first person to determine the difference in susceptibility and resistance of ponderosa pine to attack by bark beetles. He also made a major contribution to our knowledge of the predators of western bark beetles. There are seventeen unpublished and three published papers of Person referred to in *Biology and Control of the Western Pine Beetle.* One paper published in 1931 has the title of *The Theory in Explanation of the Selection of Certain Trees by the Western Pine Beetle***.**

Another major contribution by Person was his training of people under him, including George Struble, Walter Buckhorn, Don DeLeon, Nick Mirov, and Al Wagner.

ERM: Do you think his work stimulated Salman's work?

RCH: I am convinced that Person's work furnished an important framework on which Salman later built. I also feel that Person was not given the credit he deserved in the concept of risk. Person left the Bureau when Salman arrived on the scene, and worked for the experiment station in the redwood region. He was later quite active at the Washington level in the selection of research personnel for foreign assignment on FAO [Food and Agriculture Organization] projects. Person has retired and is living in Alamo, California.

ERM: Now we come to another famous man, K. A. Salman.

RCH: Dr. Ken Salman was quite a dominant figure at the Berkeley lab. Craighead had picked him to replace Paul Keen who was being transferred to Portland, Oregon to head up the new station in the Northwest. Salman was a big, husky individual, a really aggressive person. I was working under his direction and got along well with him. I had a lot of respect for his ability. Of course, he had just developed his risk concept and sanitation salvage. My contribution to that project was rather minimal, although I did assist him in some of his later calculations when he was getting his article ready for publication.

ERM: Your special training in statistics has been of much value in your wok. Was this area of expertise one that many of your colleagues came well-equipped with, or was it something that has developed in the profession only in recent years?

RCH: I think it's a fairly recent development so far as the average researcher is concerned.

ERM: Were you one of the first to be well-equipped in the statistical method?

RCH: At that period of time I was one of the leaders in the field. When Beal became chief of the division, he asked me to set up a special survey school at Fort Collins, Colorado to teach statistical methods to all of the survey and control men in the Bureau.

ERM: Ken Salman must have loomed rather large not only physically but in other ways.

RCH: Ken was a real aggressive person with a mind of his own. I remember one experience I had while driving with him on a backwoods road between Tennant and Mt. Shasta. I had plenty of previous experiences with his woods driving like a madman. On the Tennant trip we were driving along and hit a bump and heard a clunk-clunk-clunk, but Ken never faltered until we came to a place where we had to stop. He tried to get his car started again but it wouldn't start. After looking under the hood we discovered that we had lost our battery and had just been running on the generator. I've had some rather hairy experiences driving with him. It made no impression on him to say, "Ken, you'd better slow down a bit; you might meet a hunter." Ken and I never had any serious problems and got along well together.

Ken was very well respected by industry people. Of course, he was a big competitor of Paul Keen. Salman had his risk and sanitation salvage philosophy and Keen, his tree classification.

ERM: Where did Salman go after he retired?

RCH: He moved to Turlock, California where he bought a farm, and later he moved to a farm in Missouri. In my opinion Salman's resignation from the Bureau was a tragic move because I think he had real potential in the research field.

ERM: Did he leave because he was miffed with the administration of the Bureau?

RCH: Salman had some problems with Craighead which led to his resignation. He passed away several years ago.

ERM: Would you rate him among the more important men of forest entomology?

RCH: Considering the short time he was in research, he accomplished some rather important results.

ERM: How well did you know R. E. Stevens?

RCH: Bob Stevens is another man who worked for me in surveys. He helped out in control supervision on some major control projects on the lodgepole needle-miner and Douglas-fir tussock moth as well as annual surveys of insect damage. Bob is a very capable researcher and did a fine job on the history and habits of the pine reproduction weevil. He acted as project leader after Eaton's death and later left the Berkeley station to take a job in Washington as Beal's assistant. After Wygant retired, Stevens was transferred to the Fort Collins lab, where he is still working as project leader.

ERM: G. R. Struble is another famous name.

RCH: George Struble started working for the Bureau in 1926 on a temporary assignment when the lab was at Stanford. He was given a permanent appointment in early 1927. During his early career he worked under Hubert Person's direction at the Cascadel and Buck Creek field bases on various aspects of the western pine beetle problem. In 1938 George was placed in charge of the Miami field laboratory on the Sierra National Forest, where he carried on research on the mountain pine beetle, the lodgepole needle-miner, and the California five-spined engraver. George and I collaborated on U. S. Department of Agriculture Circular Number 964, *The California Five-Spined Engraver, Its Biology and Control.*

ERM: I see that he lives in retirement at Vacaville, California. He must be a man in his eighties now.

RCH: I would expect him to be in his late seventies, since he graduated from Stanford in 1927. I have a copy of his memoirs which I hope can be made a part of our history. We also have a paper by C. B. Eaton.

Galen Trostle was another survey man who worked for me. He came to the Berkeley station from Coeur d'Alene in 1954 where he had been working since 1949 for Phil Johnson on tussock moth problems. He worked at the Berkeley lab for a few years and then was transferred to the Ogden lab and has since been transferred to Portland, Oregon to Region 6 where he is in charge of insect and disease management in the Division of State and Private Forestry.

ERM: To what extent do you feel the Berkeley station has been a training ground for people in this field who have moved on into other areas of the country?

RCH: I think its contribution is really quite significant when you consider the list of people we've been talking about, where they went after they left the station, and the contributions they have made. Many of them rose to rather high administrative levels. I think the training they received at Berkeley has been fairly significant. Just to mention a few — Keen, Bongberg, Wygant, Wickman, Eaton, Stevens, Yuill, Bob and Mal Furniss, and we probably should include Bob Callaham who got his start at the station.

ERM: Has the Berkeley station been considered the primary or one of the primary stations of the Forest Service in this area?

RCH: I would classify the Berkeley station at the top. I am proud of some of the people that worked under me at the Berkeley station who later became prominent leaders in the field.

ERM: What do you recall about A. S. West?

RCH: Al West was a Canadian who worked on the Modoc National Forest under Salman's direction, about 1937 to 1940. His project was research on the California flatheaded borer, which was thought to be causing decadence in ponderosa pine and thereby contributing to high risk. He carried on his studies at the Hackamore field base. In order to closely observe the behavior of this insect, he constructed a cage about forty feet in height which completely enclosed a ponderosa pine tree. West could control the population of insects within the cage and furnished a good micro field laboratory for his studies. The primary reason for the study was due to Salman's theory that the flatheaded borer was the primary cause of the development of high risk in a ponderosa or Jeffrey pine tree.

ERM: Have you ever known an insect to be reclassified from a secondary to a primary?

RCH: It depends quite a bit on the condition of the tree. Normally, if a tree is growing under optimum conditions, a so-called secondary will be unable to kill it. However, if the same tree is under environmental stress due to some adverse climatic influence or damage by fire, then the secondary will be able to kill it.

ERM: Does the population of a given insect sometimes radically change in such a way as to make it no longer a secondary but one of primary importance?

RCH: That's true. Just through the sheer weight of numbers, a secondary insect might become primary.

ERM: So the assignment of secondary and primary status does change as the population of the insect changes.

RCH: Generally.

ERM: Let's move on to B. E. Wickman.

RCH: Boyd Wickman is a real good friend of mine. I was his merit badge counselor for forestry when he was working on his Eagle Scout rank. As a result of some of his scouting work, Boyd became interested in forestry. While he was still in high school, I gave Boyd a job as a summer assistant on a temporary basis at Hat Creek. As a result of his experience at the Hat Creek field lab, he decided to specialize in forestry, and after graduation from college he became a permanent employee of the station. When I changed from Hat Creek to Berkeley and came down as assistant to Eaton, Wickman took over the Hat Creek field lab. He was in charge from 1952 until about five years ago when he was transferred to the Portland station. Boyd has done a lot of real good research. He is another example of a person who doesn't have a Ph.D., but his list of publications is greater than mine. He is a very good writer and has a good analytical mind. He has done a lot of work on insects associated with white fir, horntails, or wood wasps in burned timber. Since he has been in the Northwest, he has become the leading authority on the Douglas-fir tussock moth and is now project leader for that insect. Boyd is a real sharp researcher and has produced a lot of very creditable research results.

ERM: Here's a man whose interest was aroused and his first job was given to him in this field by his involvement in the Boy Scout movement and through knowing you. Subsequently, he pursued that interest to become a professional in his own right. To what extent does there exist a plan to recruit young men and women to go into this field?

RCH: I am not aware of any systematic plan for such recruitment. But I think we should be making a real effort to recruit promising young people into this field.

ERM: Do you feel that the Boy Scout movement affords as much opportunity today for doing this as it did years ago?

RCH: I've had a lot of experience with scouting but have been rather inactive for the past ten years, so it is difficult to evaluate the old program with the new. I know that there has been some recent change in emphasis and philosophy where now they are admitting girls to the Explorer program, which may be a good thing in that the girls now have a better opportunity for field experience in selecting an outdoor career. I was Explorer advisor for more than ten years and did most of my leadership work with the high school age group or a few in the first year of college. I had a lot of experience in training and furnishing a wilderness experience to that type of boy. I think opportunity is there, through the merit badge program, to get a pretty good insight into the outdoor professions. Merit badges are available in such topics as insects, forestry, conservation, wildlife, botany, zoology, and the like, whereby scouts can get the feel of some of these professions if they are properly instructed.

ERM: Is there any program to recruit young people for the field through their employment on summer projects?

RCH: I don't know of any in forest entomology. I think the Forest Service in Region 5 is doing something along that line, through offering summer experience to young people who have an interest in forestry. Their visitor orientation program offers some opportunity for employment, I believe.

ERM: Describe N. D. Wygant for me.

RCH: Noel Wygant worked for me for a short time while he was at the Berkeley station during the period of 1940 to 1942, on studies of the physical characteristics of high and low risk ponderosa pine at the Black's Mountain experimental forest. Earlier in his career he worked for Jim Beal at the Fort Collins station, on problems in the shelterbelt area. In 1942 Wygant was transferred to Fort Collins to take charge of that station which had been inactive since Beal left in 1939. Noel continued in charge of the Fort, Collins station until his retirement some years ago. He is still living in Fort Collins.

ERM: J. S. Yuill was also associated with you.

RCH: Yuill is another person who worked with me up at Hat Creek for a short time. He was working on chemistry problems in the development of insecticides for control of bark beetles. He was also working very closely with Patterson on his tree injection studies. He left Berkeley to enter the service and upon his return was transferred to Beltsville, Maryland where he was placed in charge of that station. Yuill concentrated much of his research at Beltsville in the development and the application of insecticides from the air, in cooperation with Eaton and Bob Heller. He was an outstanding authority in the aerial application of insecticides. He was also a station leader. Yuill is retired and living near Silver Springs, Maryland.

ERM: That covers completely the list of personnel that the station has prepared for my reference.

RCH: Yes, these were the early workers, most of whom have retired.

ERM: In the area of more modern investigations and remote sensing and insecticide evaluation, there are additional names which you might want to comment on, such as W. F. Bailey.

RCH: Yes, that is “Beetle” Bailey.

ERM: Is he the original “Beetle” Bailey?

RCH: Yes, he is the original. He's quite a character. I've had the pleasure of working with him on some control projects, particularly in aerial observation. He is probably one of the best aerial observers in the country. He could fly over an area and map in infestations more accurately than anyone that I have ever run across. He's also done a lot of work in the aerial application of photography. One of the boys at the Monterey meeting presented a paper by Bailey on this particular topic just last week.

ERM: Who would you say was the pioneer in the field of aerial observation and photography?

RCH: Bob Heller is without question the pioneer in the field of remote sensing. John Wear is another pioneer in this field. I did some work with John Wear and Bob Pope from the Portland station, on the first use of aerial photos to detect forest insect damage in California. In my opinion Bob Heller would be considered the father of aerial photography in the United States. Not only in the photographic field but also in the application of insecticides from the air. Heller is also a pilot. He pilots the station plane especially equipped for remote sensing. I've had the pleasure of flying with Bob a few times and taking some pictures of tent caterpillar damage to range plants in northern California and southern Oregon. Heller recently retired from the station and is now teaching remote sensing at the forest school at the University of Idaho.

ERM: Another one who is retired is R. C. Wilson.

RCH: R. C. Wilson worked on forest inventory primarily and carried on a special study on the use of satellite data in forest resource surveys.

ERM: How about S. L. Wert?

RCH: Steve Wert worked for Heller. He carried out a special project to determine the effectiveness of the use of aerial photos to detect and evaluate damage by the Douglas-fir beetle on the Six Rivers National Forest. Wert resigned from the station to accept a job with Earth Satellite Corporation at Berkeley, where I worked very closely with him on my NASA [National Aeronautics and Space Administration] project in Yosemite. He has since resigned and is now working for the California State Division of Forestry on California Forest Practice Act regulations.

ERM: Is there anything more you would like to add about this group that worked in remote sensing?

RCH: Originally when we were in the Bureau, there were two branches of remote sensing: the eastern one at Beltsville, Maryland under Bob Heller; and the western one in Portland under John Wear. In 1965 both units were consolidated at the Berkeley station under the direction of Heller. From 1965 to 1972 the unit worked cooperatively with several universities and the National Aeronautics and Space Administration in collecting and analyzing data obtained by high-altitude aircraft and satellites to determine their effectiveness in measuring stress in forest and range areas and also for measurement of various ecological factors. When Heller retired, R. C. Aldrich was placed in charge. This unit now has been moved to Fort Collins, Colorado.

ERM: There is a third group under the heading of Insecticide Evaluation. Who were the key people in that group?

RCH: This project was established at the Berkeley station in 1964 with A. D. Moore in charge. The objective of this project was to seek safe, selective, non-persistent chemicals and formulation for control of forest insects and also develop methods of aerial application. When Moore retired, Don [Donald C] Schmiege took charge, and more recently R. L. Lyon replaced Schmiege and is still in charge. Some of the key people in this project include George Downing and Paul Buffam in field testing of insecticides, both of whom have moved from Berkeley. Other key people who have worked on this project include C. E. Crisp, on phloem-mobile systemic insecticides; T. Andrews, on metabolic chemistry and toxicology of insecticides in the environment; R. B. Roberts, on insecticide chemistry and toxicology; P. J. Shea, on insecticidal effects on target and non-target populations; and C, B. Williams, on field evaluation of chemical insecticides.

ERM: You have talked to some extent about the Hat Creek forest insect field laboratory. What about some of the other field laboratories?

RCH: There is a similar field laboratory on the Sierra National Forest at Miami, where George Struble was in charge for a number of years. Prior to the establishment of these permanent headquarters, there were a number of temporary field bases including the first one established in 1927 at Cascadel on the Sierra National Forest. In 1928 a second field base was established at Buck Creek, on the Modoc National Forest, and in 1937 a third was established at Hackamore, also on the Modoc. In addition to these temporary bases, the Bureau had facilities available to them at the Black's Mountain experimental forest on the Lassen National Forest, which served as a base for studies of risk and demonstration of sanitation salvage logging. In addition, the station has an important field laboratory at the Institute of Forest Genetics at Placerville.

ERM: That's the old Eddy Tree Breeding station?

RCH: Yes. R. H. Smith, who replaced Eaton, is in charge of this laboratory, and it is his principal base for studies of host resistance to bark beetles, protective sprays for bark beetles, resin systems of pines, and pine reproduction weevil.

ERM: There I also the Tuolumne Meadows station.

RCH: This is a summer station furnished by the National Park Service and has served as a base for much of the research work on the lodgepole needle-miner by Struble until his retirement, and now is manned by T. W. Koerber who is continuing research on the miner.

ERM: How about the other current research staff at Berkeley?

RCH: W. D. Bedard, Jr. is the son of Charlie Bedard whom we talked about earlier. He is working on bark beetle behavior and pheromones, doing a lot of cooperative work with Dr. David Wood, who is teaching forest entomology at the University of California at Berkeley. C. J. DeMars, who formerly worked for me in surveys, is carrying on research of bark beetle population dynamics and is attempting to develop a system for measuring populations of the western pine beetle in currently infested ponderosa pines. G. T. Ferrell is in charge of the Hat Creek field lab and is studying the host resistance to the fir engraver. He is currently attempting to develop a risk rating system for the true firs similar to the one for pines. L. E. Greene is doing insect culturing and research information storage and retrieval. T. W. Koerber is studying the biology, ecology, and control of seed and cone insects; insect pests of forest regeneration; and lodgepole needle-miner. He is currently doing some cooperative work on seed and cone insects with the Weyerhaeuser Company in Oregon. Koerber was one of the important cooperators on our NASA project to try to detect insect damage from satellite imagery in Yosemite National Park. P. E. Tilden is in charge of the Miami field lab and doing field tests with pheromones.

I mentioned the work of R. H. Smith, who heads up the biology, ecology, and control unit as project leader. Smith has made an outstanding contribution to the control of bark beetles through his research in the South and West in the use of lindane as a protective spray, where one application may be effective for as long as two years.

One thing I neglected to mention when I was discussing insecticide evaluation is the difficulty of evaluating the effectiveness of an insecticide application out in a forest area. The spray plane may fail to fly over the target area, or you may get an unexpected change in wind direction and intensity, or sudden increases in temperature may result in the spray going up instead of down.

ERM: Describe the work of W. E. Waters.

RCH: W. E. Waters replaced Beal as chief of the Division of Forest Insect Research in Washington. Subsequently, he was assigned to the Berkeley station on a special assignment to head up the integrated management systems unit. His responsibilities were in the development of pest management systems and conceptual framework and technology. In the past much of our control strategy involved a single system, such as control with chemicals, compared to an integrated system where an attempt is made to use a combination of factors; possibly chemical plus cultural plus the use of parasites and predators. Waters is an outstanding statistician and has developed many new concepts in the analysis of research data. Waters has recently been appointed dean of the new School of Natural Resources at the University of California, Berkeley. Prior to his becoming chief of the division, he was station leader at the Northeastern Forest Experiment Station where he worked on the gypsy moth. Waters also helped to conduct the survey school that I put on in Fort Collins in 1951.

Personnel of the Division of Forest Insect Investigations, Bureau of Entomology,
USDA, at a survey methods workshop, Fort Collins, CO, Feb. 1951.
(From left) Front row: Ralph C. Hall, Jack W. Bongberg, Phillip C. Johnson, Ed Merkel,
(Row 2): Leslie W. Orr, Jack M. Whiteside, Wm. E. Waters, Harvey J. MacAloney;
(Row 3): John F. Wear, Noel D. Wygant, Robert C. Heller, Bill H. Wilford, Richard I. Washburn;
(Row 4): Wm. F. McCambridge, Tom T. Terrell, Fred B. Knight, S. Davidson.

ERM: Is there anything you'd like to say about the library and librarian at the station?

RCH: The station has a rather complete library under the able leadership of their librarian, Bruce Yerke, who has developed this into a fine workable library. I would also like to mention the old Bureau library which I consider to have considerable historical significance, and one that I would like to have you see sometime. It is of particular significance in unpublished reports on forest insects in California and Oregon dating back to the early 1900s.

ERM; Bruce has done original work in the realm of bibliography and the computerization of library services at the station which have been used in other areas of the Forest Service. He's a well-known authority in that area.

RCH: He has developed a system of getting out a bimonthly bibliography of current research papers which is of help to the researcher and the practicing forester in the field. It's called the Pacfornet Monthly Alert. It is very useful in bringing you up to date on what's happening in technical literature. It's very well indexed.

ERM: Another aspect of the station in Berkeley has been the editors. They've played an important role, too, have they not?

RCH: They have, particularly Clyde Walker. Clyde furnished our division with some unusually effective service while he was editor. Clyde was especially helpful to me in getting my message across in much of my technical writing.

ERM: How did you use hybrid pines to control the pine reproduction weevil?

RCH: You remember when we were discussing the use of aerial sprays, that we had seven different projects where we had sprayed with DDT to control the pine reproduction weevil in pines planted in brush fields? John Miller was carrying on some research on the weevil. Under natural field conditions he had observed that Coulter pine seedlings were never killed by the pine reproduction weevil. So he set up a test where he forced attacks on Coulter pine, but was never able to get any mortality. He reasoned that Coulter and Jeffrey pine might be compatible and might be successfully crossed. In cooperation with the people at Placerville, they developed a hybrid between Coulter

and Jeffrey, which Miller tested under forced attack in cages. He discovered that the hybrid demonstrated a high degree of resistance to weevil damage and suggested that we carry on resistance tests under field conditions where weevil damage was known to occur. In cooperation with the Lassen and Shasta national forests in the spring of 1948, we established a series of three plantings: one near Big Springs on the Lassen; one near the McCloud nursery; and one near Mt. Shasta on the Shasta. We tested one hundred pure Jeffrey pines against one hundred Jeffrey-Coulter hybrids and twenty pure Coulters. After running tests for seven years we concluded that the Jeffrey-Coulter hybrid was indeed resistant to damage by the weevil. We found that for every hybrid killed there were an average of seven Jeffries killed.

Although we had demonstrated that we had a good substitute tree to plant in brush-fields, the big problem was to develop enough hybrid planting stock to make an imprint on the amount of land needing planting.

In the meantime we discovered another thing that we had suspected earlier, that competition from brush was an important factor in tree mortality from the weevil. In the early brush field plantings the practice was to plow a furrow through the brush and plant the trees in the furrow, but soon roots from adjacent brush invaded the planted area and used up a lot of the moisture available to the tree. Later the Forest Service changed their site preparation procedure and completely removed all the brush before planting, which has pretty well solved the weevil problem.

ERM: What is the purpose of restoring plantations on the brush fields? Have they commercial value or do they serve some other purpose?

RCH: The main reason is to build up the growing stock for timber production in future years. Many of the brush-fields in California were the result of severe forest fires which destroyed all of the trees over vast areas, which meant that there was little or no chance for these areas to naturally restock themselves. Therefore, the Forest Service was faced with the prospect of many idle acres unless they regenerated by planting. The current policy of the Forest Service is to plant as many of these idle acres as planting funds permit.

ERM: Obtaining enough money to plant has been one of the problems the Forest Service has had over the years.

RCH: Yes, planting is a costly proposition, and the number of acres planted is regulated by the number of planting dollars. I feel that the Forest Service has done a very good job to date on reclaiming brush fields. Under current market conditions I would estimate that it would cost in excess of one hundred dollars to plant one acre of brush field.

ERM: Is the Jeffrey-Coulter hybrid a fast or slow growing species?

RCH: The hybrid is much faster growing than the parent Jeffrey. Coulter will grow faster than the hybrid, so the hybrid is about halfway in between its parents.

ERM: Re those plantations beginning to show some real promise?

RCH: Yes. Of course, these are just experimental plantings made in 1948 and are now more than twenty-five years old, with some of the trees about thirty feet in height.

ERM: How much application has there been of the idea once it was proved feasible? Have there been any large plantings of hybrids?

RCH: No, because of the lack of planting stock, both from a time and expense standpoint. In order to produce hybrid seed, it is necessary to start with a newly developing Jeffrey pine cone, place a bag over it to prevent pollination from outside sources, then introduce the pollen from a Coulter pine and leave the bag on until all the production of local pollen is completed. This is a terrifically expensive as well as time consuming method of seed production.

ERM: Which is the one that has the tremendous big pine cone?

RCH: That's the Coulter pine. We found out a rather interesting thing that we didn't expect in the survival of Coulter at Mt. Shasta. Coulter is usually very susceptible to damage from freezing, and we did not expect any of our Coulter pine to survive the well-below-zero temperatures in our three plantings. For some reason the Coulter planted at Mt. Shasta showed a high survival, and I had the pleasure of picking some cones from several trees last year.

ERM: I got my first Coulter pine cone when I visited the Placerville station years ago. I'd like to ask you a little bit about the Placerville station. Did you know James Eddy of the Institute of Forest Genetics?

RCH: Just barely. I met him once at the station, but it was a very brief visit.

ERM: How is his work evaluated by people in your field?

RCH: I think they feel that Eddy made a rather outstanding contribution to the science of forest genetics and laid the foundation for later major developments in this field. I understand he started the institute as a private individual and later turned it over to the Forest Service. Some rather important contributions in the field of genetics have been developed at Placerville by Pete [Francis I.] Righter, Jack Duffield, and Bob Callaham.

ERM: We've done a series of oral history interviews with some of the people from the institute.[10]

RCH: Oh, have you? I consider Eddy's work a rather outstanding example of a private individual making a major contribution in the way of facilities to a government agency.

ERM: What can you relate about the remote sensing program?

RCH: This is a subject in which I have a deep interest and some expertise. I cooperated with John Wear in his first test in California, attempting to use aerial photos to detect insect damage caused by the western pine beetle in southern California. We used three types of film—black and white, regular color, and infrared, or false color where the color of the image is reversed and a green tree will show up as red while an insect killed tree will show up as green. John piloted the plane and took the pictures. We were testing out different types of film to see which gave us the best delineation of damage. Miller and Patterson had demonstrated that pictures of insect killed trees taken on the ground could easily be detected by using black and white film with a G or A filter, where the infested trees show up as white. In the aerial approach we found that both color and color IR gave satisfactory results with little difference in the two. It was pretty much a matter of personal preference, except that the color IR appeared to be better on cloudy days. Bob Pope, from the Portland station, and I did the ground checking of the images. We had hoped to be able to distinguish the green infested trees which had been killed but which had shown no visible evidence of fading. We found that if the fade was not visible by eye, it did not show up on film. However, any tree which had changed color was easily detected.

ERM: In other words, you can actually single out individual trees on the ground in your survey from aerial pictures.

RCH: Right. In other words, you can use an aerial photo as a spotting map. In the old days trees were generally spotted on a map constructed on the ground by a three-man crew consisting of a compassman and two spotters. These spotting maps, which were used later by the control crew, were subject to some error from pacing and from improper compass direction.

ERM: How much has this influenced the effectiveness of dealing with the problem of bugs?

RCH: The aerial technique has resulted in a major breakthrough in some major control projects where the logging of the infested tree is used as a control method. The first step, using this method, is to acquire a set of aerial photos at the proper scale, usually about 1/8,000, using color or color IR. These photos are taken to the laboratory where experienced interpreters search out and mark on the photos all the infested trees they are able to find. Random samples of these photo spots are ground checked to determine the accuracy of the interpretation, and the count is adjusted accordingly.

ERM: And you can go out and deal with them with a field crew.

RCH: Yes. In 1965 we had the occasion to use this method in controlling an infest at ion of the western pine beetle in ponderosa pine and the mountain pine beetle in sugar pine, on a ten thousand-acre tract of timber in the Big Bend area of the Shasta National Forest. The property was owned jointly by R. L. Watt and the U. S. Forest Service. This was a cooperative project between the experiment station, the regional office of the Forest Service, the California Division of Forestry, and the private timberland owner. I represented the private owner on a consulting basis. We used aerial photos to actually spot the infested trees, and then using the photos in the field, the loggers located the trees for felling.

ERM: What statistics have you been able to compile to show the real benefits of this work?

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[10] For further information, see *Eddy Tree Breeding Station: Institute of Forest Genetics*, interviews with Gladys Austin, Francis I. Righter, William G. Cumming, Alfred R. Liddicoet, Jack Carpender, and Nicholas T. Mirov, conducted by Lois C. Stone (Berkeley, California: University of California and Forest History Society, 1974).

RCH: We worked with Phil Langley, who at that time was with the station and who had developed a system called multi-stage sampling whereby you take aerial photos, interpret them, and then estimate the number and size of the infested trees. This is done by making a 100 percent evaluation of the photos, and then you pick certain small samples to ground check. If, for example, your photo sample showed four trees and your ground sample showed six trees, you adjust your photo estimate upward. By combining all of the ground samples into a regression equation you adjust your total estimate. In the Big Bend project where all the infested trees were logged, our total log scale was only four percent higher than our estimate from the photos.

ERM: Has this been put into effect by anyone other than the federal government?

RCH: In the Big Bend case the stimulation for the project came from the private owner who paid for the aerial photos. Although it was a joint private-federal-state project, it was one where the private lumberman was willing to put up the money for it. So it does have some practical application from the standpoint of industry.

ERM: Do some of the big landowners like Crown Zellerbach and Weyerhaeuser and Georgia-Pacific use this?

RCH: It's standard procedure for both industry and the federal government in making volume estimates to use aerial photos.

ERM: Are they applying this in dealing with bug problems on their lands?

RCH: I think they are to some extent. I know Weyerhaeuser has. The Forest Service has done it on several projects, one of which was a cooperative project between Bruce Roettgering of the region and Steve Wert of the remote sensing unit of the station, in estimating the volume of Douglas-fir killed by the Douglas-fir beetle on the Six Rivers National Forest.

In that particular project the country was so rugged and inaccessible, with very few roads and trails, that to do the job on the ground would have taken months. In 1952 George Downing and I conducted a survey of similar damage near Willow Creek using a helicopter as transport. Using aerial technique they were able to complete this job in about two weeks with an error estimate of about 10 percent. C. J. DeMars, in cooperation with Heller, has been using aerial photo technique in his population dynamics study near McCloud. Bill [W. H.] Kline at Ogden, Utah and William M. Ciesla at Missoula, Montana have done some very effective work in developing procedures for using 35 and 75 mm cameras to obtain photos of damage from the air. Bailey has also done a considerable amount of work along this same line.

ERM: Now you've moved another step forward, and you've begun to take photographs from an earth satellite.

RCH: Right.

ERM: What part have you and others at the station had in the development of that idea?

RCH: Bob Heller has had several grants from NASA to utilize satellite imagery to evaluate many forest and range problems with particular emphasis on stress. One of his major projects was working with the mountain pines beetle in a serious outbreak area in the Black Hills. While I was with the Natural Resources Management Corporation, I was awarded a NASA contract to see what we could do about detecting damage from insects in Yosemite National Park. Our major concern was with two insect problems: one, a defoliator, the lodgepole needle miner; and two, a bark beetle, the mountain pine beetle in lodgepole pine. Trees heavily defoliated by the miner were brown in color, while the trees killed by the bark beetle had various color tones from salmon red to gray. We determined that it was possible to detect visually three different degrees of mortality from the bark beetle — heavy, medium, and light — and also to detect defoliation damage from satellite imagery with a rather high degree of precision.

ERM: At what elevation above the earth is this done?

RCH: The images are taken at slightly more than five hundred miles. The images we used were from a camera-like sensor system, a multispectral scanner (MSS) system. NASA used selected color filters to obtain black-and-white photographs simultaneously in each of several energy bands. Then through further manipulation it was possible to obtain photographs in false color (IR), which were the ones we analyzed. The black-and-white photos were of little use in visually detecting damage. I had hoped that we might be able to substitute satellite imagery for some of our aerial reconnaissance that we do at least once every year. But at this stage of development it does not appear to be practical.

ERM: Because of the cost?

RCH: There are several factors involved. One important factor is weather conditions when the satellite is over the target area, which is every eighteen days; and it is extremely rare to have a cloud-free day in our forested areas. Another factor is the labor of visually scanning the photos for damage, which must be massive before it can be detected. Another factor is the long delay in receiving the prints from NASA. There is a possibility that we might be able to do something mechanically through using a computer. I have been doing some work with General Electric, testing their Image 100 Multi-Spectral Scanner, but it appears that this machine is not sensitive enough to be able to detect difference in mortality, or to differentiate defoliation damage from mortality, or to differentiate dome shadows from lakes, all of which I was able to do visually.

ERM: Which, of course, supports those who say that the computer will never take the place of the human observer.

RCH: Right. The computer can do some rather marvelous things if it is properly programmed, but this again is something where you need some real experience in properly directing the computer.

ERM: You conducted a survey methods school at Fort Collins, Colorado in January 1951. What was its purpose?

RCH: The purpose of this conference was to review present survey methods and objectives, and to offer training in the field of survey design and. analysis of survey data. Representatives from each of the five regional field laboratories presented recent field data which served as a basis for the design of sampling methods which were to be used during the next field season.

It was agreed at the conference that all intensive surveys made in the future should be specifically designed so that a valid estimate of the sampling error would be possible. Such a plan would guarantee that each future estimate of loss would have a qualifying standard error which would indicate the relative reliability for such estimates.

ERM: How many different control groups came to this meeting?

RCH: There were eight different groups represented as follows: from Ogden, Utah, L. W. Orr, in charge of the station, and R. I. Washburn; from Fort Collins, Colorado, E. P. Merkel, F. Knight, M. F. McCambridge, B. E. Wilford, and N. D. Wygant; from Coeur d'Alene, Idaho, P. C. Johnson and Tom Terrell; from Portland, J; W. Wear, S. T. Davidson, and Jack Whiteside; from the Northeast, W. E. Waters; from Beltsville, Maryland, R. C. Heller; from the Washington Office, Assistant Chief H. J. MacAloney; and from Berkeley, J. W. Bongberg and myself.

ERM: Was this the first such conference on the subject?

RCH: Yes.

ERM: Who projected the idea in the first place?

RCH: Jim Beal, chief of the division, appreciated the need for such a conference and made the request to Paul Keen to have me conduct this survey school.

ERM: Was there any great difference of opinion on the basics discussed in this conference?

RCH: Not on basics, but in specific details there was some difference of opinion as to how to proceed.

ERM: Was that largely because you were dealing with different insects?

RCH: That's right; there was no standard survey procedure which would apply to all insects. A survey of defoliator damage, for example, would differ widely from a survey of bark beetle damage.

ERM: Of those that attended the conference, who would stand out in your memory?

RCH: Two in particular stand out who had considerable background in statistics and sampling methods, and who greatly assisted in the instruction. These were W. E. Waters and Fred Knight, who was then at Fort Collins but who later moved to the University of Michigan to replace Sam Graham, and has since gone back to Maine as head of their forestry department. Another key person was Bob Heller, an outstanding expert in remote sensing.

ERM: What subsequently resulted from this school? Was a decision made to repeat it regularly thereafter?

RCH: One of the principal achievements was that survey methods were standardized for the country, and that reports of survey results had a qualifying reliability statement. No decision was reached on future schools.

ERM: Did any resolutions come from the group?

RCH: A report was prepared by the participants covering sampling designs for five major bark beetles, a major defoliator, and use of aerial methods in western forest insect surveys.

The school was conducted on a very informal basis, somewhat in a workshop manner where there was ample opportunity for full discussion of issues. We also had an opportunity to get out in the woods and observe an outbreak of the Engelmann spruce beetle near Rabbit Ears where we waded around in the snow at around eleven thousand feet in elevation.

ERM: Were these just the project leaders?

RCH: They were not all project leaders but were all people who had various responsibilities for surveys of forest insect problems. L. W. Orr was station leader at the Ogden station, and H. J. MacAloney was assistant chief of the division in Washington.

ERM: The number of people in responsible positions in this field was still relatively few.

RCH: That is correct. You see, 1951 was before the impact of the federal Forest Pest Control Act. It was beginning to build up steam. Five years later the picture had changed considerably in regard to the number of people involved in surveys and control.

ERM: What impact did World War II have on the program?

RCH: It had a rather serious impact by draining off some of our key research and survey people. We lost Bongberg, Eaton, Yuill, and DeLeon [went to serve in the military].

ERM: They were people that you could hardly replace.

RCH: No attempt was made to replace these men during the war period.

ERM: What effects did this have upon the work?

RCH: Some of the work had to be dropped, such as Eaton's work with termites in federal installations. I took over Bongberg's survey responsibility which cut into my time for research.

ERM: To what extent did the war effort curtail the financial support of the program?

RCH: It had some impact, but we were able to continue on with a skeleton crew that was left without any real serious problems, as I recall.

ERM: Did you find that strictures were imposed because of the war?

RCH: Our main restrictions involved travel by auto which made it very difficult to get our annual cruises completed on permanent sample plots.

ERM: Did you have any prisoners of war to help, or anyone like that?

RCH: Yes, we were fortunate in having a five-man camp of civilian public service people assigned to the Hat Creek lab. These were conscientious objectors, not prisoners.

ERM: How important was their participation?

RCH: The people I supervised at Hat Creek were Mennonites from Modesto. They were all very productive congenial people, and I was impressed with their character.

ERM: Did any of those people continue in the entomological field after the war?

RCH: As far as I know, they didn't. They were all ranchers and after the war they returned to their ranches. They were very much interested in controlling the western pine beetle by burning the infested bark. I think they had the feeling that they were doing something very productive, protecting the forest by burning up pests.

ERM: Were there other impacts of war on the program?

RCH: I don't recall any serious impacts at the Berkeley station.

ERM: Did you lose any of the key people as a result of the war, either through death or through going into different fields when they got out of the service?

RCH: We lost three rather productive workers when the Berkeley men returned from the service. Eaton, Yuill, and DeLeon transferred to Beltsville which left just Bongberg at Berkeley.

ERM: Perhaps we can talk now about the silvicultural control of the western pine beetle by thinning in the Modoc National Forest in 1963. What was the significance of that project and who was the originator?

RCH: Actually the insect involved in this project was the mountain pine beetle rather than the western pine beetle. I was pretty much the spark plug on this particular project. In the old days we believed that once our virgin forests were logged over that our bark beetle problems would be over. However, as the young stands approached the pole size, we began to observe bug problems in these new stands.

One particular problem area developed on the Modoc National Forest in the Joseph Creek area, where a very dense stand of seventy-year-old stands were very, seriously damaged by the mountain pine beetle. It appeared that the most serious damage was occurring in areas where the trees were the most dense and where competition for moisture was the greatest. We thought that if we could thin the stand, reduce competition, and do it systematically, we could control the mountain pine beetle. We tried out a thinning experiment on a few acres at the height of the epidemic and found that we greatly reduced damage in the area thinned. This was the first test of its kind in California. We followed up and thinned all of the outbreak area and achieved almost complete control. This was in 1963, and I was through this area last year and didn't see a single bug tree. This was a demonstration of an indirect method of control and was an example of something you could do through forest management.

ERM: A kind of preventive medicine?

RCH: Right.

ERM: To what extent has the method been put into practice?

RCH: It has been quite widely used in the West by the Forest Service to remove competition in stagnating second-growth ponderosa pine stands, but this was the first time it was used to attempt to control an insect infestation.

ERM: By both public and private?

RCH: Mostly by public agencies.

ERM: When this is done, are the thinned trees sold?

RCH: In our particular experiment there was no market for the removed material, but today the chip market would probably utilize much of the thinned material. We just left the material on the ground.

ERM: You didn't burn it?

RCH: No, we didn't burn it because we felt that there would be no particular hazard from Ips because of the time of the year the area was thinned.

ERM: You were cutting primarily ponderosa pine?

RCH: Yes, second-growth ponderosa pine.

ERM: With whom did you work on the Modoc National Forest?

RCH: I worked closely with Kenneth Smith, the timber management man, and his assistant Glen Davies. Smith was a real practical management expert. He felt like I did that the thinning project would be worth a trial and we got excellent cooperation from the Modoc forest at that time I was working out of the regional office in San Francisco in surveys and control.

ERM: Were you living out in the woods on this job?

RCH: In this particular case, we were living in town since we were only about thirty minutes from the job.

ERM: How big a crew was working with you?

RCH: I had one person from the Modoc forest working with me on marking the trees to be thinned, and to evaluate the results of the thinning. The Forest Service administrative branch provided the people to do the thinning.

ERM: Could you describe a typical day's work?

RCH: In this particular experiment a normal day would mean getting up at 6:30 a.m., being out in the woods not later than 8:00 a.m., leaving the job about 5:00 p.m., getting back to town for dinner about 7:00 p.m. That would be a normal day's schedule on this type of project.

ERM: Describe what you actually did out in the woods.

RCH: Let's back up to the period before we got into the process of thinning. First, we decided that we needed some measure of the insect population in the infested trees. So the first thing we did was to take bark samples of about ten square inches and then count all the insects within that sample, segregating them according to their development, such as eggs, small larvae, mature larvae, pupae, and both new and old adults. From these counts we could determine whether the tree was heavily or lightly infested and whether the insects were thrifty or sickly and what the prospects were for a rapid increase or a rapid decline. This gave us a little bit of insight on what we could expect those insects to do in the future. In this particular case we found the broods to be thrifty, with little or no signs of disease or parasites, with every indication that they were going to continue on an epidemic level. This was part of our biological evaluation of the project. After we decided that the insects were going to continue on their rampage, we set up this experiment to try to control them through thinning.

ERM: In terms of acres, how large were these tracts that you were working on at any given time?

RCH: The whole Joseph Creek basin contained several thousand acres, but the critical epidemic area covered about seven hundred acres.

ERM: When you blocked out the area to do your thinning, did you provide any kind of a buffer zone around the infested area and include that in the study too?

RCH: Initially we thinned just a few acres and left an unthinned check strip adjacent. We soon found that the thinned plot survived with very light damage, while the adjacent unthinned area continued to suffer severe damage. It was soon apparent that the thinning had reduced competition so that the residual trees had improved in vigor to the point that they were very resistant to damage from the mountain pine beetle, even though the beetle population remained very high in the adjacent unthinned strips. Then after we were convinced that the thinning was effective, we thinned the whole infested area.

ERM: What was your method of marking the trees?

RCH: We marked them with paint spots.

ERM: Did you mark the trees or would others in the crew join you in this?

RCH: Initially I marked the trees and then trained one of the men from the forest to finish the marking.

ERM: What follow-up did you do to check your results?

RCH: For several years after the thinning, we made an annual survey of the whole area to determine how many trees had been killed.

ERM: How soon after the thinning was that done?

RCH: We made our first survey in the fall of the year following the spring thinning. After the second year we were pretty well satisfied that the thinning had solved our bug problem. Today that stand is in a very thrifty condition with practically no bark beetle damage.

ERM: What are the natural enemies of this pest?

The mountain pine beetle has very few natural pests that are of any significance. The most important insect enemies of the bark beetles are the C**leridae,** a group of predaceous insects sometimes referred to as bark beetle destroyers, which devour the larvae and adults. At times, particularly during the winter period, woodpeckers feed on the larvae by boring through the bark. The bark beetle destroyer adults run up and down the bark when a tree is being attacked by bark

beetles and destroy some of the attacking adults. They lay eggs in the bark which hatch into larvae, and these feed on the bark beetle larvae.

ERM: The larvae work on the larvae of the other insects.

RCH: Right. George Struble carried on quite a bit of research on these predators. His objective was to mass produce these insects and use them to control bark beetles, but he had real difficulty in breeding up great numbers.

One interesting thing about these predators is that they are a pretty good thing to watch out for when spotting green infested trees. Almost without exception if you observe a bark beetle destroyer on a tree, you can be pretty sure that this tree is being attacked by bark beetles. In their study of pheromones, the boys at the station have discovered that the synthetic scent they produce to attract bark beetles will also attract great numbers of bark beetle destroyers.

ERM: Are there any birds that act as control agents in this particular bug problem?

RCH: Woodpeckers are the principal bird predator on bark beetles. In the case of the western pine beetle, they chip off the bark and remove the larvae or pupae. In some cases they will eat about 90 percent of the population of a tree. In the case of the mountain pine beetle, they bore through the bark to get at the larvae which are in the cambium area. We have very little research information on the importance of woodpeckers in controlling bark beetles. My own feeling is that they are, an important brake on the population at endemic levels, but are of less importance under epidemic levels, principally because the woodpecker is unable to increase in population as rapidly as the insect.

ERM: Has there been any noticeable decline in the population of woodpeckers?

RCH: We have very little scientific data on this topic. One thing we had hoped to do in the early days was to breed up woodpeckers and turn them loose in the infested areas, but no serious attempts were ever made along this line. One important thing that regulates the population of woodpeckers is the number of snags available for their nesting sites. One of the provisions in the new California Forest Practice Act deals with the removal of snags on logging areas. The State Board of Forestry has a committee set up to study this problem and to come up with some recommendations on how many snags to remove or to leave. The forest experiment station at Portland is currently carrying on research projects on the populations of woodpeckers in forested areas, as well as information on their territorial requirements. From this information we may be able to take steps to increase our population of woodpeckers.

ERM: Usually when food greatly increases, the population of predators which feed on it also significantly increases. Has any study been made relative to that generalization?

RCH: This is a rather classic principle so far as defoliators are concerned, where as the host population builds up, the parasite-predator-disease population also builds up and ultimately causes a crash in the host population at a high epidemic level. We have never been able to demonstrate this same principle with regards to bark beetles.

ERM: The other day when we were on a walking tour out in the jungle here, we saw how the ants prey on the larvae of termites in the trees. Do ants work in the same way on other larvae?

RCH: Yes, they do. Of course, ants have practically no effect on bark beetle populations while they are still protected under the bark, but once the bark is removed and the larvae are exposed, then the ants, have a field day. We had a rather interesting sidelight on ants on a recent control project on the Modoc form, of the budworm on the Modoc National Forest. We found that after spraying with Dylox, the budworm larvae would drop out of the trees on the ground, and the ants would carry them away like mad. This is another problem on which very little is known, but Tom Koerber at the station thinks ants can have a very significant impact on insect populations which are exposed.

ERM: Do you think that the populations of these destructive insects in the forests of the West derive from man's impact upon the forest, or from other factors?

RCH: Man may have had some impact on the buildup of pests in the forest through disturbance by road building and to some extent by logging, but some of our most serious bark beetle outbreaks in the early 1900s occurred prior to man's major disturbances.

ERM: Before there was any cutting?

RCH: In those days cutting was very minimal, and serious outbreaks were occurring in areas where there was no disturbance by man.

ERM: How can you be sure of that?

RCH: Mostly by inference, but we have pretty good records as to where the big outbreaks were located, and most of them were in no way associated with logging activities.

ERM: Maybe data on losses was not as reliable then as now.

RCH: As a matter of fact, our data on losses at that time was probably more reliable than it is today, which is perhaps a little surprising. The early forest entomologists, such as Evenden, Chamberlin, Miller, Patterson, and Keen, were making much more effort to find out what the impact of insects was, through carrying out a much more intensive type of survey than we are today.

ERM: But they had far fewer trained people to do the work at that time.

RCH: Yes, but the people who were doing the work were pretty well trained in how to make surveys of insect damage; maybe they were more efficient in those days which would compensate for lack of numbers. I feel that the survey results back in 1915 or 1930, and even extending to 1952, were more reliable than we are obtaining today.

ERM: Then there has been regression in the whole area of survey work?

RCH: As far as the impact of insects, yes. There is no question that our surveys of timber volume are far superior today, but our information on how much timber is being killed annually by insects is very deficient.

ERM: Are we in need of a more intensified effort in this respect?

RCH: Currently the Forest Service is very much concerned with the amount of timber being destroyed by bugs and is committed to trying to do something to recover some of these losses. However, the big weak link in the chain is how much volume of dead timber there is on a state-to-state basis, and they have to rely largely on guesses to obtain these data. Up until the time I retired from the Forest Service, I was making an annual estimate of the amount of timber destroyed by various insect species by tree species. These estimates were based upon data supplied by various of our cooperators as part of the California Cooperative Forest Insect Detection System, sponsored by the California Forest Pest Control Action Council. My annual estimates of losses were largely based upon the opinion of our cooperators as to the level of losses estimated for each insect species as to whether it was normal, below normal, or above normal. In the calendar year of 1959 I received and analyzed a total of 506 cooperative detection reports. I was also furnishing this information to the state of California for inclusion in their annual publication of losses due to agricultural and forest insects.

Since my retirement nobody seems interested in continuing annual estimates of losses, and the state is no longer provided with information on losses from forest insects.

ERM: It would seem that almost concurrently with the conclusion of your survey methods school at Fort Collins, the compiling of reliable data went into a decline.

RCH: The school furnished us with better tools to use in predicting or assessing damage in a specific area or unit, and I did make use of some of the biological evaluations in making my estimates.

ERM: Do you see any sign of renewed interest in older methods of surveying?

RCH: I don't think we'll ever go back to our old 320-acre plots, since I have shown that these large plots were not too efficient in terms of manpower expended. In 1950 I designed a sampling method utilizing 2-1/2 acre plots, where ten of these would provide essentially the same information as a single 320-acre plot. This was to be on a cooperative basis. The industry people were going to put in a series of the smaller plots on their ownership, with the Forest Service and Indian Service installing a series on their ownership. The design was accepted and approved by the California Forest Pest Control Action Council, and the system started in 1952 by industry who established thirty of these plots. The companies participating included McCloud, Soper-Wheeler, Winton, and Collins Pine. The Bureau put in a similar number on Forest Service ownership, but the system was abandoned when we came into the Forest Service.

ERM: Did those who had been making annual reports directly to you now cease to do so?

RCH: Eaton decided that the Bureau no longer had the responsibility for mortality information and the system was discontinued.

ERM: Did any of these private groups continue it themselves?

RCH: They did for a while, but since this was to be a cooperative project and the Forest Service dropped out, industry then lost interest.

ERM: Was it discontinued largely for lack of federal funding?

RCH: The need, for federal funding would have been minimal since installation and annual checking of mortality would be done by the cooperators, and federal funding would have been necessary only for compiling the information and the submission of an annual report.

ERM: This was about the time Dick McArdle became the new chief of the Forest Service. He was an old friend of yours from the University of Michigan days. What was Dick's attitude toward this?

RCH: I don't know. I felt that I didn't want to ask any special favors from Dick because of friendship. I tried to work through the system through my superior, Eaton, and my policy was not to go over his head farther up the line. My guess is that McArdle never knew about the problem.

ERM: Who do you think was primarily responsible for cutting this off?

RCH: Charlie Eaton was the man directly responsible for this decision. I guess I was a pretty poor salesman in defending the program, but Charlie said, "We're in the Forest Service now, and they have a survey division to get this kind of information, therefore it is their responsibility to do it."

ERM: But the survey unit within the Forest Service compiled data on other grounds than insect infestation did they not?

RCH: Right.

ERM: And they had no experience or interest in that area?

RCH: The Forest Service did have survey plots, but they did not have a single entomologist or pathologist on their survey crew who could tell what organism was responsible for mortality. Since these plots were not checked on an annual basis, identification of the causal organism became much more difficult.

ERM: Was any opposition organized to reverse this trend?

RCH: I think this trend was an in-house problem. It was just something that was decided at the station leader and director level.

ERM: And those who worked under them never disputed it?

RCH: I disputed this with Eaton, but I was never able to change his mind. I felt that this was an opportunity to cooperate with industry to collect mortality information that was of great mutual interest.

ERM: When did this cooperation with industry begin?

RCH: In his memoirs Burke has a rather good resume of industry's role in cooperative control. In reviewing the early insect control records of Burke, Hopkins, and Webb, I have been impressed with the role of private timberland owners, their awareness, concern, and initiative in instituting action. Industry cooperation with the Bureau dates back to the early 1900s.

ERM: Most of the work done at the Forest Products Laboratory in Madison, Wisconsin was in wood technology. In other words, it concentrated on developing the potential use of forest products?

RCH: That's correct. There was some work done on insects affecting products, such as powder post beetles, and some work done on wood-staining fungi, but nothing in respect to insects in living trees.

Except for some emergency funding, the first act which supplied special funds for forest entomology was the Forest Pest Control Act of 1947. I believe the first federal allotment made for cooperative control of forest insects was back in 1911 when $15,000 was allotted to the northeastern Oregon forest insect control project. One of the key supporters for this allotment was W.I. Whetmore, president of the Wallowa Timber Company.

ERM: Professional forestry in this country had its beginnings in the 1870s with the birth of the American Forestry Association. But as far as a profession with trained foresters, it didn't really get much of a start until the turn of the century. Apparently in those early years a real rapport existed between

industry and the profession and between the old Bureau of Forestry, the new Forest Service, and the Bureau of Entomology.

RCH: Particularly with the Bureau of Entomology.

ERM: That relationship went into decline with the controversy that developed about 1908 or 1909 between Pinchot and the industry and between Teddy Roosevelt and industry. You came into the profession not too very long after that. Can you recall this relationship between the public and private sector in respect to forestry?

RCH: The controversy to which you refer was a little ahead of my time. But I think the main reason for the good cooperation between industry and the Bureau was the fact that so far as industry was concerned, the Bureau was primarily a service organization whose main purpose was to help the landowner solve his insect problems, compared to the Forest Service who had a competitive product to sell to industry.

ERM: The Forest Service was the custodian of the national wealth in the forests.

RCH: Right, and the industry must have some of the federal timber in order to operate.

ERM: But until World War II or after, the Forest Service was more a custodian than a seller. There might have been some sales, of course, but they were relatively minor compared to what they've been since that time.

RCH: That depends upon the area. In the early days outfits like Red River and McCloud had plenty of their own timber, but still in northern California there was considerable timber sold by the Forest Service prior to World War II. It has been my experience that industry, although they might have had some very major differences with the Forest Service on policy, when emergencies arose about control of bugs, you could count on their full support.

ERM: You were a young professional just out of college in the 1920s. This was a time of great debate within the profession on matters of national forest policy. In the 1920s there was a struggle over what kind of legislation was needed to protect against fire. There were the beginnings of a real scientific research program. Earle Clapp, Sam Dana, and Raphael Zon, and a number of others were key figures. Legislation emerged, like the Clarke-McNary Act of 1924 and the McSweeney-McNary Act of 1928. What do you recall about the struggle over proposed legislation?

RCH: I never really got very much involved with legislation in the early days. But it seems to me that the biggest bone of contention was the matter of federal regulation of timber harvest. I think we generally got strong industry support for all those bills you mentioned.

ERM: But in many cases there were two different bills—one which industry supported and one which federal people supported. There was the Pinchot school and there was the Greeley school. The Greeley school came out on top in the twenties with the passage of the Clarke-McNary Act. Do you remember any of that?

RCH: I don't remember much about that controversy. But times haven't changed much in regard to that type of controversy. A case in point is the controversy on the Monongahela problem and the legislation amending the Organic Act of 1897.[11] There are several bills in the hopper on that subject. One has the support of industry and, I believe, the Forest Service and the Society of American Foresters, while the other has the support of many conservation organizations. So the game has changed a bit with more general public interest expressed today than was the case in the 1920s.

ERM: Do you suppose that oftentimes men who are trained in science are disinterested in the political realm, and that disinterest works to their disadvantage because their work is not given adequate recognition?

RCH: Unfortunately, that has been the picture until recently; the scientist is now beginning to realize that who is better qualified to express a scientific point of view than the scientist himself? This is a very healthy change in attitude. Of particular significance is the change in the new policy of the Society of American Foresters where now they are taking strong policy stands in the political arena and are speaking for or against proposed legislation. They have the professional expertise. Who better could speak for the profession than the Society of American Foresters?

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[11] Forest Reserve Act of 4 June 1897,30 Stat. 11, Also known as the Sundry Civil Appropriations Bill.

ERM: Doesn't this derive from the fact that they are so concerned with the narrower aspects of the problems that apply to their field that they haven't developed the necessary skills to enter the political arena?

RCH: The Society has grown up and is now willing to make a position statement on controversial issues. Last fall the council appointed a task force to study the impact of the Monongahela decision on Forest Service timber sales policy. They have prepared a comprehensive professional report on their findings stating the SAF position on this matter.

ERM: Isn't there now pending in the state of California a new forest practices act?

RCH: A new Forest Practices Act for California has been enacted, and I am glad to say that professional foresters both through the local section and chapters and as individuals have made important contributions to this act.[12] The professional forester is beginning to have a little political clout. About two years ago the state forester of California was fired. He was a very competent professional who was doing an outstanding job. The Northern California Section of SAF went to bat to get him reinstated. In addition, individuals in and out of the section spoke their piece, and he was reinstated, I believe, largely because of the support of the professionals.

ERM: This is a part of the maturation of the profession, then?

RCH: Right.

ERM: There have been some outstanding people in the past who have had great influence in legislative matters, certainly Pinchot, Greeley, and Graves. More recently I suppose you would have to say men like McArdle and Ed [Edward P.] Cliff.

RCH: In the West some of the key people besides Greeley, would be Bill Hagenstein, Swede Nelson, the late Bill Schofield, John Callahan, and Emanuel Fritz.

ERM: Would you care to make any further comments on the relationship of industry to this whole picture?

RCH: I think we have pretty well covered the subject. I mentioned the article by Stewart Edward White in the *American Lumberman* December 1916, "The Tree Killing Beetles of California and Possible Remedies," in which he pointed out that industry was much more concerned over the bug problem and were taking corrective measures, while the federal people were failing to react.

ERM: This must have come as quite a blast to the Forest Service.

RCH: White did not specifically mention the Forest Service and talked about the "Government." One place in his article he says, "So ignorant, or apathetic, are the heads of Government departments that in a badly infested district, where private lumber companies spent $5,093.98 on 5,000 acres, the total appropriation for this purpose by Government for all its 23,600 acres was $300.00." Since White was talking about California, there is little doubt that he was talking about what is now the U. S. Forest Service.

Keen earlier mentioned Jackson Kimbel, secretary of the Klamath-Lake County Forest Protection as an outstanding industry supporter, and I have mentioned Elmer Hall, logging superintendent for the McCloud River Lumber Company, who I consider the dean of industry people dedicated to the protection of timber from the ravages of bark beetles. As early as 1912, in cooperation with two men from the Bureau, Elmer sent his most experienced cruiser, Dan Stevens, to Bray, California to check an outbreak of bark beetles, which were later controlled by the company. Elmer continued annual control of McCloud holdings from then on and in 1944 presented a paper at the Western Forestry and Conservation annual meeting, entitled, "Thirty Years' Experience with Bug Control."

ERM: Was he a forester?

RCH: No Elmer was not a forester. He was a practical logging superintendent who understood the damage that was being caused by bugs on McCloud ownership, and he was willing to do something about it.

ERM: Did industry back up its interest sufficiently with their own cash, or did they expect the state and federal governments to shoulder most of the burden?

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[12] Z'berg-Nejedly Forest Practices Act of 1973 (Public Resources Code Secs. 4511-4628, Chapter 880, 1973 Calif. Statutes) amended by Chapter 174, 1975 Calif. Statutes (Public Resources Code Sec. 4514.3).

RCH: Elmer's philosophy was, "This is our problem and we'll solve our own problem. We will also cooperate with others on any problems." He did that on the Burney-McCloud project. Elmer did not have his hand out for government subsidy. He was willing to spend his own hard-earned cash to control forest insects on the McCloud River Lumber Company lands.

ERM: Did you find other operators less inclined?

RCH: When I arrived in California, most of the operators in northern California were fairly conscious of their bug problems. I recall one incidence in 1940 when I pointed out a problem to Ken Walker, president of the Red River Lumber Company. Ken responded with, "Oh, Doc, that's just bugs." At that time stumpage was about $1.50 a thousand, and they still had many years of cut on their own land. Later, Ken became convinced that bugs were important and now on his Walker forest tract near Viola, his foresters are very conscious of their insect problems. Ken's chief forester, Roy Richards, has developed an outstanding program of logging out his infested trees prior to the emergence of the beetles. He conducts an aerial inspection of the Walker forest involving about 100,000 acres several times a year to detect any insect killed trees. I was doing service work with the company while I was in the Bureau and Forest Service, and since retirement have been doing consulting work for them. A few years ago I did a research job for Ken on a scale insect on sugar pine and have often participated in aerial inspections with Roy. You will see practically no snags on Walker forest because of their very effective salvage program. So I think Ken has changed his opinion a little bit about "just bugs."

ERM: In other words, when bugs become bucks, people become interested?

RCH: Right.

ERM: And only then?

RCH: Well, economics is a stimulus for sure. Another outstanding industry person is Waller Reed, chief forester for Collins Pine. Wally had a real good background in entomology while working with Phil Johnson on the Bureau hazard inventory, and in his contact with Ken Salman in the development of his risk marking and sanitation salvage. Wally initiated a modified sanitation salvage program on Collins Pine soon after Salman proposed it. I did a lot of work in the early days with Lloyd "Wampy" Wambold, one of the earliest private foresters with Diamond Match. Some of my other cooperators include Bill [William M.] Beaty and Quenton Bruton formerly with the Shasta Forest Company, a management company for the old Red River Lumber Company holdings of about three quarters of a million acres. Bill is now with W.D. Beaty and Associates while Quenton is a private consulting forester. Bill [William] Welder, forester for Fruit Growers Supply Company, is one of the pioneers in bug control on private land. Robert Leatherman, formerly with the McCloud River Lumber Company, a protégé of Elmer Hall, has continued the tradition of bug control on company lands which recently were taken over by U. S. Plywood. Other cooperators include Bill [William H.] Holmes, forester for Soper-Wheeler, and Bob [Robert L.] Maben, forester for Winton.

ERM: Did Dave and Charlie Wanton ever take an active interest?

RCH: I never knew either of these gentlemen, but their foresters were very much interested in insect control.

ERM: Some of the various organizations that sprang up to deal with this problem were industry-oriented, Western Forestry and Conservation Association, for example.

RCH: Yes, one of their principal committees is the Western Forest Pest Committee. I am a member of their executive committee. Paul Keen played an important role in getting this committee formed. This committee is the parent committee of the regional pest councils including the California Forest Pest Control Action Council, the Northwest Forest Pest Action Council, the Intermountain Forest Pest Action Council, the Northern Rockies Pest Action Council, and the British Columbia Forest Pest Control Committee. Representatives of these councils meet for a two-day conference annually at the meeting of Western Forestry.

In my opinion one of the most important organizations that we have in California is the California Forest Pest Control Action Council which is now in its twenty-second year. The council, which is made up of industry, federal, state, university, and conservation groups, serves as a clearinghouse for control decisions, approves all control actions, and acts in an advisory capacity for the State Board of Forestry.

Another very important west-wide organization is the Western Forest Insect Work Conference.

ERM: What would you single out as being its primary achievement?

RCH: Its primary achievement is that it offers an informal annual forum for the exchange of professional ideas between the Canadians and American forest entomologist. It is an organization where the researchers and survey and control people get together to discuss mutual problems.

ERM: Were transcripts made of those conversations?

RCH: Yes, these are published in the annual proceedings.

I have been quite active in the council, having served as its first vice-president, under Bill Schofield who was president. I also served as chairman from 1970 to 1972. Paul Keen and Ernie Kolbe were the spark plugs in the formation of the council. T. F. Arvola, deputy state forester, another charter member, has prepared a history of the council entitled, "The Past Twenty Years, California Forest Pest Control Action Council."

ERM: Was Arvola involved in insect control work himself?

RCH: Yes, he's been a very strong supporter for insect control since he has been working for the California Division of Forestry.

The council was formed in 1951 in recognition of the need for close cooperation between land managers concerned with forest pest problems. Primarily an advisory and coordinating group, the council sponsors a statewide cooperative forest pest detection survey; publishes an annual, report on forest pest conditions; studies, endorses, and supports desirable pest control action; reviews control needs and programs; stimulates action where needed; and provides a forum for exchange of pest control information. The council is also the advisory body for the California State Board of Forestry. In my opinion this is one of the finest organizations dealing with control strategy.

ERM: Does it have its counterpart in other western states?

RCH: Yes, there are similar councils in the Northwest, the Northern Rockies, the Intermountain region, and British Columbia. Our title differs in that we have "Control" in ours since our founders felt that control was an important word. Royce Cox, chief forester for Potlatch and past president of the Western Forestry and Conservation Association, is one of the outstanding industry members in the Northern Rockies council. He is very much concerned with losses due to insects on Potlatch ownership and has hired Dr. G. B. Pitman, consultant from Boyce-Thompson, to attempt to solve many of his insect problems.

There is one other thing that I would like to comment about the industry program of salvaging insect infested trees. I pointed out the work being done on Collins, Walker forest, Fruit Growers, and McCloud. In the early part of the program they had a problem in mobile logging equipment which was practical in picking up scattered individual infested trees. Bill Hannan at Old Station pioneered in developing a self-loading logging truck that could move around in the woods and remove individual trees at a modest cost. This stimulated others to develop similar equipment which greatly accelerated the salvage program on private land. About fifteen years ago, in cooperation with Dick Montague, district ranger at Hat Creek, we developed a system for salvaging bug loss on the Hat Creek ranger district on the Lassen National Forest. Dick divided his district into four units and then let bids to small local loggers to annually remove all of the infested trees in each unit. The bid specified that the logger would be responsible for the location of each bug tree: in his unit, which after spotting would be verified by one of the district forest management men. This program resulted in the Forest Service getting the infested trees logged at a minimum administrative cost. The program worked quite well until the ranger was transferred and then it fell apart. The big advantage of that program was that most of the infested trees were removed while they still contained brood and before the infested tree had deteriorated. This had a double-barreled effect through insect control by removing broods and through recovering nearly full value of the timber. The current Forest Service philosophy today on salvage, with very few exceptions, is that such salvage programs as they sponsor are conducted two or three years after the trees have been killed by insects, so they get no control effect, and most of the value of the salvaged tree is greatly reduced, as is the return from the sale.

ERM: Is there any evidence that when infested trees are felled the bugs in them exit from the host and spread into healthier growth?

RCH: Normally in such a case there is very little loss of brood in the felled tree. Occasionally small pieces of infested bark will break off in yarding or loading, but this is minimal.

ERM: What is the role of the land manager in survey and control?

RCH: In the early days, prior to 1911, Hopkins decided that the Bureau had responsibility for both surveys and control supervision, but starting then the Forest Service was given the responsibility for surveys. These were handled in Region 6 by Alex Jaenicke and in Region 5 by Ralph Hopping.

Based upon these surveys it was the Bureau's responsibility to recommend for or against control. In 1961 the Forest Service regions took over the responsibilities for both surveys and control on federal land and gave the states the responsibility for surveys and control supervision on private land. It is generally assumed that the responsibility for insect detection falls on the landowner, whether federal, state, or private.

From 1951 to 1961 I was in charge of the cooperative pest detection program for California which was sponsored by the California Forest Pest Control Action Council, with the principal contributors being foresters employed by private, state, and federal agencies. When an insect problem was detected, the cooperators would submit a pest detection form reporting the insect responsible for the damage, the acreage involved, and an estimate of number and size of the trees killed, as well as the epidemic status. In 1959 I received a total of 506 detection reports which furnished a pretty good base on which to evaluate the insect situation statewide.

I always felt that it was a mistake to transfer the survey and control responsibility from the station to the region. The station had available a full staff of researchers to whom they could refer problems in survey and control methods and techniques, which although theoretically available to the region, have been very sparingly utilized.

In Jim Beal's recollections, he says, "Perhaps the most disappointing thing to me when I was division chief was the loss of surveys to the control unit. I thought it was a mistake at the time, and I still think it was a mistake to move that out of the unit which had handled it for so many years."

ERM: Administration is constantly getting shuffled around, right?

RCH: Right. I'm also disturbed about the shuffle that happened when the Bureau was transferred to the Forest Service. At first there was no major change in administrative structure, since Eaton maintained his title of chief of the division of forest insect research and reported directly to the director of the station, but after Eaton died the structure changed drastically.

When R. E. Stevens replaced Eaton, there was no longer a division of forest insect research at the Berkeley station level. The Forest Service broke up the old division into two projects: Biology, Ecology and Control of Forest Insects, under Stevens; and Insecticide Evaluation of Forest Insects, under A. D. Moore. These two men had the title of project leader; and whereas Eaton, as division chief, reported directly to the station director, the project leaders now report through an assistant director.

Of greater concern to me was the change in division status at the Washington level. After Waters, who was then chief of the division, was transferred to the Berkeley station in 1973, the national division concept apparently changed to a project level where one project director would be responsible for two or more projects. But at the present time there is no project director who is responsible for what used to be the old division of forest insect research. My concern in both cases is that the status of forest insects at the station and national level has been significantly watered down.

ERM: What about the role of the land manager in surveys and control in relationship to the National Park Service, the Bureau of Indian Affairs, and the Bureau of Land Management?

RCH: In the early days the responsibility for surveys was much the same as for the Forest Service. The other federal agencies never did have anybody officially assigned in similar roles to those of Jaenicke and Hopping. The responsibilities for surveys in the other federal agencies were usually assigned to a member of the staff in their forestry department as a part of his routine duties. When surveys were taken over by the Forest Service regions in 1962, the Forest Service then was responsible for all surveys, including detection through aerial inspection, for all federal agencies. The responsibility for control was assumed by each federal agency, but the control supervision was done by the regions.

ERM: Recently the National Park Service apparently has taken a different attitude about fire. They are now letting fires burn, particularly in the Jackson Hole national park area. Does this policy have any counterpart in insect control?

RCH: The National Park Service has recently reviewed their long-standing policy of control of insects and have made some rather major changes. In the early days, starting in 1914 for example, Yosemite National Park started a program of controlling bark beetles, particularly in the more highly used areas of the park. They continued this policy for more than fifty years and also carried on several control projects on the lodgepole needle-miner. They have now apparently decided that they will greatly reduce their control effort in Yosemite; and in some parks like the Lassen Volcanic, they will do no control at all. Their philosophy seems to be that if it is a native insect, it's just part of nature and will let nature cure the problem.

I'm not so sure that I completely agree with their policy. If it is a native insect in a wilderness area, then perhaps I would agree. But if it is the same native insect in a highly used campground where the insect-killed trees are a serious hazard to the camper, such as happened in the Coulter campground of the Teton National Park a few years ago, then I think the Park Service should reconsider their "no control" policy.

ERM: Is there any real difference between the quality of work done for these other agencies and that done on national forest land?

RCH: No. I think the Forest Service is providing very effective service on all federal lands.

ERM: What about the role of state and federal agencies in survey and control for private owners?

RCH: When we were in the Bureau, we provided service for all owners irrespective of status, big and small, industry, and all federal and state land. But recently the region has decided that the state would assume responsibility for private land and that the Forest Service would confine their efforts to federal land.

ERM: Is this a part of the decentralization policy that has been in vogue in recent Washington administrations?

RCH: Probably part of the same philosophy. This has been in effect for more than ten years.

ERM: What has been the role of the private consultant forester?

RCH: Besides myself there are very few professional forest entomologists in the consulting field. Several of the prominent ones include G. B. Pitman, J. P. Vite, the late B. H. Wilford, and Hector Richmond from Canada. A number of professional foresters who are members of the Association of Consulting Foresters provide consulting services on forest insect problems. Two prominent ones in California include C. V. Sikora and J. E. Asher. There are a few retired federal forest entomologists who are doing some consulting, but their impact is minimal.

ERM: Is there a future in such a service?

RCH: I feel that the future for a full-time consulting forest entomologist is not too bright. I think there are two main reasons for this: one is the long time tradition that the federal government, and now the state, furnishes entomological services free to industry, although I also think the level of service to the private sector has been greatly reduced in recent years; the second reason, particularly in California, is that the industry foresters, through early training schools sponsored jointly by the Bureau, the university, and the state, have a good practical background on insect problems affecting their ownership. Right after I retired from the Forest Service in 1964, which coincided with the change in responsibilities for service to industry, I did some consulting work for a number of lumber companies.

ERM: Who were some of these?

RCH: I did some work for Collins Pine, Shasta Forest Company, Michigan-California Company, R. G. Watt & Associates, Walker forest, and Pacific Gas and Electric Company. I did considerable work with PG&E in training their foresters in survey methods, particularly in aerial survey technique to the point where they could take over on their own. I worked quite a bit with Roy Richards, chief forester for Walker Forest, on a variety of problems including a special research project on the black pine leaf scale in sugar pine, and aerial inspection of their holdings. In the early days I worked with Quenton Bruton from Shasta Forest Company in an annual aerial inspection of about six hundred thousand acres of company land. The Shasta Forest Company under the leadership of W. M. Beaty was the management unit for the residue of the old Red River Lumber Company which the Walkers owned.

ERM: Is it still in their control?

RCH: It's been pretty well broken up recently through the Kimberly-Clark Company acquiring the old Ralph L. Smith holdings.

I have also done some contract research on range insects for the Pacific Southwest Forest and Range Experiment Station, as well as two research jobs for Region 5. For the past two years I have been acting as a consultant on insect problems for the Klamath Indian tribe. I am currently doing some consulting for Shasta County on a combination black pine leaf scale-western pine beetle problem in the Glenburn urban area involving about fifty different home owners.

I also did a job for Hammon, Jensen, Wallen & Associates in measuring more than seven hundred redwood trees to serve as a basis for a volume table for redwood trees. I also acted as executive secretary for the Northern California Section of the Society of American Foresters from 1964 through 1972.

ERM: Can we discuss the role of the states, colleges, and universities?

RCH: The role of the states in both surveys and control is of fairly recent origin. Since the passage of the federal Forest Pest Control Act, money was made available for hiring survey forest entomologists at the state level.

ERM; Was this matching federal money?

RCH: Yes. In the case of California, their federal allotment is about $20,000 annually, which is matched by the state. This is not a large budget, but it provides for the services of one full-time forest entomologist, Richard Hunt, and part time for his superior, Dan Dotta, both of whom work for the California Division of Forestry. I feel that this position is badly understaffed when compared to fire problems. Dick Hunt is a very effective worker, but since his responsibilities cover the whole state, his services are spread out pretty thin.

ERM: I would have thought they needed substantially more money than that to deal with the problems. Would you say that they are getting enough funds or should they have more?

RCH: I would say a much more realistic budget would be ten times that amount or about $200,000, when you consider the importance of the insect problem statewide and nationwide.

ERM: Do you think we are spending enough government money to deal with that problem?

RCH: I think we are approaching a pretty satisfactory level in research, with the initiation of the three crash programs I mentioned earlier.

ERM: Is public money distributed evenly to the states, or does it depend largely upon support of people in Congress?

RCH: I would think that considering the national level, perhaps the West is not faring too badly.

ERM: Better than other areas?

RCH: The West has one of the three emergency projects, research on the tussock moth; with the East having the gypsy moth program; and the South, the southern pine beetle. So maybe we are not far out of balance.

ERM: What about the roles of colleges and universities?

RCH: They have played rather an important role in recent history. When I came to California in 1938, there was only one man teaching forest entomology in the West. This was W. J. Chamberlin, who started teaching at Oregon State University in 1916 and continued until his retirement in 1960. I believe that Chamberlin was the first man to teach forest entomology in the United States [A. D. Hopkins taught at West Virginia University prior to his becoming Chief of the USDA, Bureau of Entomology, Division of Forest Insect Investigations in 1902. His student, J. L. Webb, became the first forest entomologist to graduate in the United States]. As I pointed out earlier, Sam Graham was one of the pioneers in the teaching field, where he started at Minnesota in the early 1920s and later moved to Michigan, at which time Les Orr took over at Minnesota. Today practically every major university with a forest school has at least one forest entomologist on their staff.

The encouragement by private industry had a major impact on the appointment of a forest entomologist on the staff at the University of California at Berkeley. In 1953 at the time of their annual meeting, the California Forest Pest Control Action Council passed a resolution to the Regents of the University of California, recommending that a full-time forest entomologist and a full-time pathologist be placed on the staff to conduct research and to furnish entomological training to the foresters. This resolution was subsequently endorsed by the California Forest Protective Association, the Western Forestry and Conservation Association, the California Alumni Association, and by the California State Board of Forestry.

That same year Mr. Brooks Walker, trustee of the T.B. Walker Foundation, pledged $10,000 a year for five years to start a program of forest insect research at the University of California with the understanding that the lumber industry would contribute a like amount annually. The Walker Foundation has continued its support and in addition fourteen lumber companies have made annual contributions to this program.

This strong industry support stimulated the university to establish a staff position for forest entomologist in 1956, at which time they appointed A. D. Moore to the position. Moore was replaced in 1959 by R. W. Stark, who remained in that position until 1970 when he moved to the University of Idaho as coordinator of research. Ron is one of our outstanding forest entomologists, both nationally and internationally. He is an outstanding teacher and researcher and without any question has had a major impact in training both researchers and teachers, not only in the West but also nationwide. He was the major professor for thirteen master and fourteen doctoral candidates. Seven of his doctoral candidates are now teaching forest entomology. Nine of his graduates are in key research positions with the U. S. Forest Service and one of his graduates, N. E. Johnson, is research director for Weyerhaeuser. Stark also has had an important impact on the furtherance of population dynamics research and concept of integrated pest management.

Other forest entomologists at western universities include A. A. Berryman at Washington State; John Schenk at Idaho; Julius Rudinsky at Oregon State; Robert Thatcher at Colorado State; James Lowe at Montana; Robert Gara at Washington; and David Wood at California.

An outstanding example of industry sponsored applied research in forest entomology is the work carried on at the Weyerhaeuser Centralia Research Center under Director George Staebler. The company hired entomologists primarily to solve existing problems, namely the Douglas-fir beetle, the balsam wooly aphid, the hemlock looper, cone and seed insects, and the Sitka spruce weevil. One of their outstanding entomologists is Dr. Norman E. Johnson who gained national and international recognition for his contribution to applied forest entomological research on all of the insects I just mentioned. He has authored over 100 publications in applied forest entomology. He left the company from 1967 to 1969 to teach at Cornell and returned as manager of their southern forestry research center. He is currently on an assignment to Indonesia. The forest research center has grown in size to include about fifty top level scientists with an annual budget of over $5 million and with research programs in Oregon, Washington, North Carolina, Mississippi, Alabama, Oklahoma, Arkansas, and in the tropics, namely Indonesia.

The work of the Boyce-Thompson Institute at Grass Valley, California, under the leadership of J. P. Vite and Garry Pitman, is an example of a rather unique combination of both basic and applied research in forest entomology, together with consulting services for forest industry and forestry-oriented associations.

I had the pleasure of cooperating with Vite in his first field test with the use of olfactometers in testing the application of natural attractants to sample and control the western pine beetle and the California five-spined engraver populations occurring at epidemic levels. This test was carried out in the spring of 1962 in a local epidemic area at Meadow Valley on the Plumas National Forest. This test demonstrated that the olfactometers lost the battle with the western pine beetle when natural attraction occurred in the recently attacked ponderosa pines.

Ralph Hall with his daughter, Judy and son, Jim, at Western Forest Insect Work Conference, Sacramento, California, 1993. Hall was honored at the Conference banquet for his efforts to preserve a history of western forest entomology, including oral history interviews.
Photo by Malcolm Furniss, a former co-worker of Hall and who was MC at the banquet.