WESTERN FOREST ENTOMOLOGY HISTORY:

An Interview with Robert L. Furniss

by

Ronald C. Larson

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WESTERN FOREST ENTOMOLOGY HISTORY--Interview of

Robert Livingston Furniss[1]

Ronald C. Larson: This interview with Robert L. Furniss in Portland, Oregon, October 14, 1977 is part of a joint project between the United States Forest Service and the Forest History Society of Santa Cruz, California. To start off, I want to get a brief sketch of your personal biography.

"I was born in Portland, OR, Sept. 8, 1908. My parents (Clinton C. and Ruth W. Furniss) just happened to be passing through Portland, I believe. (He was oldest of 5 sons and one daughter.) I was raised entirely in the East. I started school in Maine, and in about the second grade we moved to Pennsylvania. Then, along about high school age, we moved to Waverly, New York. I graduated from high school there, (he was Valedictorian) and then went to Syracuse University Forestry School in 1926. I graduated (cum laude) in 1931." (He was captain of the Lacrosse team and played center-field man.)

Why did you go into forestry?

"I spent a couple summers in the Lehigh Valley Railroad locomotive shop (Sayre, PA near Waverly, NY) and this convinced me that forestry was the thing for me. I didn't want a life of that kind. As a youngster, I was in the woods a good deal. Machinery, and the dirt and grime and noise of the locomotive shop turned me off completely. My father was a physician, a surgeon, who went to Maine for health reasons. My very earliest life was in some of the lumber camps there. So I had a little of that feeling from the very, very earliest time. I had just an impression of logs and logging and milling. In those days, they ran the logs down the rivers. I distinctly remember some of the aspects of this with the rivers full of logs and then dynamiting the log jams and things of this sort. It just appealed to me and I took it up. I had incidentally, been interested, as many youngsters are, in collecting insects. And so these two interests came together in forestry school and I majored in entomology there and minored in silviculture, combining forest management and forest protection.

Was there a very extensive program in entomology?

"Yes. That was the leading school in forest entomology in the country. M. W. Blackman was the Department Head there. He had worked from time to time with the Bureau of Entomology, and he taught insect taxonomy. His successor, McAndrews, gave courses that were more oriented toward insect ecology and biology. Other notable professors were (H. P.) Brown in dendrology and wood technology who was an outstanding man, and Pennington in botany. They had a fine staff at Syracuse. So we got kind of a mixture and Blackman was very well acquainted with (F. C.) Craighead (Head of the Bur. Entomology, Div. Forest Insect Investigations in Wash., D.C.) and each year, Craighead would come up and talk with Blackman and the students who were specializing in forest entomology. And then Craighead would give them the opportunity to get summer employment. They were not subsidized in any

[1] The transcript of the taped interview was not edited by RLF prior to his death on Dec.7, 1980. In 1987, I prepared this edited version which was reviewed by his widow, Frances (Heath) Furniss, Tigard, OR. The photos and minor revision were added to the final copy, Jan. 2008. All words within parentheses or brackets are mine; those with numerals refer to the appended bibliography. (Malcolm M. Furniss, Moscow, ID).

way. If you were coming West, you paid your train travel. In my case, I came back flat broke. I was working my way through school and was broke most of the time. When Craighead came up there (in 1929), I expressed an interest in going to the station at Asheville. But, for some reason or another, he had lined up somebody else, and the opportunity was in the West. It happened to be out of Coeur d'Alene, Idaho. Well, that was fine. I got there all right, flat broke. I got into a hotel and then, in order to pay my hotel bill, I sold my box compass to Tom Terrell (laughter)."

Was Jim Evenden in charge of the Coeur d'Alene Laboratory then?

"Yes, Jim was there. And the first assignment that we had, Tom and I went out on the McGee district of the Coeur d'Alene N. F. We packed in, of course. There were only seven miles of road in the whole district at that time. And we set up a temporary camp where we would cook and so forth. Our assignment was to cover the entire district and inventory the number of mountain pine beetle-killed white pine. Our technique was one of visual mapping. We would go from our camp to the lookouts and high ridges and map what we could see (trees with reddish foliage) on a base map.

"These trees occurred in groups, maybe two to fifty or a hundred in a group. And we mapped out what we could actually count and then, at a later time, we'd take a sample and actually go to the group and then find that there were more than we could actually see, so we had a correction factor that we applied, depending upon how far we were from the group. That we were a quarter of a mile away was one factor, half a mile was something else. Well, this took us about a month and on about the twenty-eighth day, I happened to have (laughter) the base map stuck in the back of my cruiser jacket. We were up on a high ridge and we just took off through the brush, and that's very brushy country. A half hour later, when we were down at the stream bottom, I didn't have the map with the month's work on it. Well, the chances of finding that map were very, very remote. But we made a try at it. After two or three hours of searching, I was standing in the brush and happened to look down. Here was the map, just on edge like this. I suppose we were both at fault for not transcribing our notes. But we would come in, dead tired from a day's work, twenty- five or thirty miles out there in the brush, on trails and up and down. So this was rigorous work and then you had to get your meal ready. By that time you really didn't feel like transcribing. So we didn't.

"We would move base camp until we could cover this or that. I remember one time in particular, we were going far out. We would travel way out and this one day, had about thirty miles to cover out and back. When we got out at the end of the line, the tendons in the back of my knee and ankle tightened up and I couldn't do anything. Couldn't stand up, couldn't walk, couldn't do anything there momentarily. Very painful. Well, I later heard that this malady was called squeaky-heel and it certainly was, because as you walk, you could hear this thing.

"This was kind of interesting country at that time because there was a grizzly disrupting some of the trail camps. He'd come in and tear things up and of course the trail crew would leave camp for awhile. He never bothered us, but there was always this kind of interesting aspect that he might visit our camp." (laughter)

What else did you do while you worked out of Coeur d'Alene?

"After that first month, I went over to the Big Hole Basin in Montana on the Beaverhead N. F. We made a survey there of the mountain pine beetle in lodgepole pine. We would pace out

so far, then offset and come back, something in the twenty and thirty mile range, and record the beetle-infested lodgepole pine half a chain (33 ft) on either side of our compass line. The trees had not colored. We looked for pitch tubes and frass on the trunks.

"Our principal purpose was to get some idea of the total number of beetle-killed trees and determine whether the beetles had "jumped" across the Big Hole Basin, which is a treeless area of about twenty to thirty miles, maybe a little more than that. They had been conducting a very extensive control program against the mountain pine beetle with the idea of holding the beetles to the infested side. If it would jump, this would increase the cost very greatly. And actually, the project was given up at that time because it did spread.

"We had all kinds of interesting experiences there. I did put in a night camped on a mountain because...I don't know how many of these anecdotes you... (Chuckle)."

"Well, it's interesting, these anecdotes, because they give a big part of the history of forest entomology. [at this point, it is clear that RLF was on the verge of recounting some anecdotes of his experiences in Montana. The story of the night spent out in the woods and his mention that, "we had experiences of various kinds with the moonshiners," were not allowed to surface. Instead, the interviewer changed the subject each time.]

How did you get your food, your grub, when you were in camp?

"On the Coeur d'Alene N. F., we packed everything in. We caught some fish. They were easy to catch at that time, but this was just on the side. Incidentally, Tom Terrell is a great fly fisherman, dry fly fisherman. Then in the Big Hole Basin, we mostly brought it in by the old model T. There were some access roads and we could get in to a central camp situation, operate out of there for a few days, and then move camp. Then there was one other thing, between the Coeur d'Alene project and the Big Hole Basin survey, I spent several weeks on the East Fork of the Bitterroot River, Mont., at the Wetzsteon Ranch where Don DeLeon was studying the insects associated with the mountain pine beetle-- predators, parasites.[2] At the ranch we had trout three meals a day.

"We had a three-man crew, and we would go out to the end of the road and leave off the first man, then he would go out on his line, offset a mile, and come back. The next man would be let off three miles down the road. The third man, he'd leave the car parked there and then he would go. And, of course, the first man back to the car would pick up the other two."

Who would treat the infested trees?

'The next step would be to have a control crew actually make the survey. And they usually went through on a one hundred percent basis in a mechanical way--ribboning the area, looking at literally every tree. Then they would mark and map them; then the treating crews came in. Ours was an inventory process. On the Coeur d'Alene N. F., we were attempting to see whether this topographic method would be useful compared to covering the whole area. It

[2] Deleon, D. 1934. Canadian Entomologist 66:51-61; 1935. Annals Entomological Soc. Amer. 28:411-424. 1935. Entomologica Americana 15 (new series)(2):59-91 [*Medetera aldrichii*]

looked very promising but I don't know because this was the only year that I was actually working in that part of the country. This was still while I was a student, of course."

So what was next in your career? Did you go back to the university then?

"Yeah. That was in 1929. Let's see, that would be after my junior year. And the next year I went to Berkeley, Calif. Still hadn't graduated. Spent the summer and fall (1930) there with John (M.) Miller working in the Modoc N. F. We were working principally with the western pine beetle and ponderosa pine. At that time the western pine beetle was economically the most important forest insect in the country. My first years there were still in the period when the outbreak was in its height because of the drought that began in the late 1920's and continued through the 1930's. This was really right at the height of the dustbowl days in the mid-west; and California and Oregon were all suffering very severely. Probably the most severe drought in those areas in at least a hundred and fifty years according to some studies that Keen made on the tree rings, that reflected drought."[3]

Was the theory of insect susceptibility already well established by this lime? Did you know that one reason that the epidemic of western pine beetles existed was because of the drought, or was this still in the theoretical realm?

"Well, this was still being developed at that time. The details of insect susceptibility developed over quite a period of time, but by then both (F. P.) Keen and Miller were pretty well convinced that the basic problem was one of moisture deficiency. It was pretty evident that the whole forest was being decimated. Not only the mature trees but immature trees. It was occurring out towards the "desert" edge (east of the Cascade Mountains and Sierra Nevada Mountains), progressively less as you got onto the better arid (more moist) sites. So it was felt that one of the basic underlying problems was moisture deficiency. The control strategy against the western pine beetle at that time was one of a holding action, to cut down the population to the point where it wouldn't be destructive and hope that the climate would change and that the trees would become more vigorous and less susceptible."

What method of treatment was used to control western pine beetle?

"Basically cut and burn."

Do you think that the cut, slash, and burn technique had any real impact on cutting down the epidemic?

"I think not. Several things cause me to think this. But at the time we were doing the only thing that seemed possible. No one could tell that this was going to be a decade-long drought. One reason why I doubt that direct control had a lasting impact relates to a personal experience involving winterkill (21, U-4, U-7)[4]. In 1932 there was a very severe winter in which the western pine beetle populations were decimated over very large areas. Well, it was theorized that this would be the equivalent of a very effective control operation.

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[3] Keen, F. P. 1937. Climatic cycles in Eastern Oregon as indicated by the rings. Monthly Weather Rev. 65(5):175-188.

[4]See appended bibliographies

"What happens under these circumstances? Well, we looked at this. I personally looked at it at Hackamore on the Modoc N. F. and followed some of the development over the next year. The populations built back within one year, so this was a very short-term effect. The whole stand was susceptible at that point."

After your experience in California, you went back to school again?

"Yes. In 1930, I worked through the summer and fall, then went back to school for the spring term, then returned to Berkeley, California. Of course, this was the depths of the Depression at that time, and there weren't openings for foresters or entomologists or anything else. But, John Miller was quite successful in carrying some of his help along by getting university money, all kinds of emergency type funds. So we were carried along and then we were out of a job for awhile, and you just made out the best way you could."

Did you do any postgraduate work after getting your BS degree at Syracuse?

"After returning to California, I fully intended to go ahead and get a Ph.D. degree, skipping the formality of a master's thesis. I signed up for study under (E. C.) Van Dyke, and some of the very fine entomological staff there at U.C. But the economics of the Depression caught up with me and I never did follow through on this.

Bad timing, huh?"

"Yeah."

How long were you in California and what were your assignments?

"Four years total. The second year when I really came back to California, I almost immediately had an assignment in southern Oregon with Jim (J. A.) Beal. He and Keen, I assume, were interested in some of the work that I had done on the biology of the western pine beetle in slash at Hackamore (U-1, U-6). We didn't discuss this. But anyway, this prompted them to ask Miller if I could come up to Klamath Falls and join Beal in the studies he was conducting up at Keno, at Camp Two, Weyerhaeuser Timber Company. He was studying two things there. One was the possibility of removing bark beetles in an active logging operation, removing them from the woods and in effect sanitizing the woods at no added cost. In other words, allow the logs to absorb the beetles and then take them down to the mill and kill them down there.

"The other aspect was the possibility of using solar heat to control bark beetles in down logs, such as had been done with lodgepole pines to some extent. Of course, ponderosa pine is a thick bark species with much greater insulating quality. Well, Jim (Beal) had a study that related to the incidence of the sun's rays as they hit downed logs, what was the best, most favorable angle of a down log in relationship to the sun's rays. My own part was as a recorder of temperature. Under summer sunshine, some of these sub-cortical temperatures went up to a hundred and forty degrees or so, more than adequate to kill the brood. But even though the temperatures could be achieved, it meant coming and turning the logs several times. And the amount of effort that went into that was so great that you couldn't afford to do it. It was much, much cheaper to fell and burn."

"What was found by all of your researchers in the log removal process? Were you able to bring beetles out?

"Yes, a great many of them were brought out, but there was not great impact on the number of infested trees that occurred in the area presumably because of two things: the stand itself remained highly susceptible due to the drought conditions and, secondly, the influx of beetles from the surrounding areas was so great that you could hardly notice an impact.

"This is related to another thing: in essence, we were talking about the so-called trap tree program, in which you absorb a certain number of insects in down logs and then take them out. In a trap tree program, you fell trees intentionally and let them fill up with beetles and take them out of the woods. Well, undoubtedly you take vast numbers out of the woods. The test is, what happens in the woods in spite of what you've done, and, if you don't get a pronounced reduction in the remaining forest, your method is inadequate. By and large, the trap tree programs have not paid off on the residual stand. Now, there's a difference of opinion, and I have discussed this many times, including in Japan. So, this is one of the, I guess, subjective areas."

You mentioned Japan; are they having a similar problem?

"Well, after the war (World War II), the Japanese had very severe pine beetle outbreaks. The country was occupied under command of General MacArthur who had a natural resources section. The Japanese requested entomological advice on this matter. Their assumption was that during the war, they'd fallen behind in chemical control...they didn't have chemicals...and that therefore they needed advice in this area. I happened to be the one who was chosen to go over there and I did. I went over twice (U-10, U-11)."

Let's go back to Keen. It was on Weyerhaeuser land that your work was done?

"Yes, of course they were very much interested and had been for many years, so they provided housing and meals but not salaries. They provided a logging operation and they permitted us to cut trees and do all that sort of thing."

So they were quite a help then?

"Oh, terrific, terrific."

Did they have their own entomologists?

"Not at that time."

When did they start to develop their own program?

"Norm (E.) Johnson came to Centralia to their lab in the late 1950's." (Julius A. Rudinsky and Vaughn McCowan worked temporarily for Weyerhaeuser in 1953-1954, studying Douglas-fir beetle)."

The Bureau of Entomology and Plant Quarantine had a much better cooperative program with industry than the Forest Service did later, didn't it?

"Well, I don't know. The Bureau, of course, was purely a service type of organization and had a view that the clients were private, state, or federal, whoever had the problem. You provided your best technical information and you weren't concerned with policy or anything else, just the insect control problem. And, under these circumstances, in this part of the world, some of the most acute problems were on private lands. So the natural thing was to work with these people, including the Indians, who have private lands too, in a way, although the Bureau

of Indian Affairs...the Indian Service at that time, of course, had a very important function, but nonetheless these were private lands, too. And, of course, we cooperated wherever there's a problem, national parks or forests or whatnot.

"Oftentimes your recommendation might be quite at odds with, you might say, existing management policy. Well, that's for the manager to weigh these things out and, in that regard, I've long felt that the research function is not a proper adjunct to administration. I feel this now, I felt it then. That's one reason I think you should interview Warren Benedict, for example, because he thought the opposite, and I'm an admirer of Warren Benedict."

You stayed in Portland, then, for quite a while?

"No, I just came up for the summer and fall and then went back to Berkeley. I had projects of various kinds in various parts of Calif. and, of course, at that time we were right in the depths of the Depression. I took all the examinations that were given. Junior Conservationist, Junior Forester, and all the rest. I qualified as a Junior Forester, and that list was maintained for quite a long time. When I came to Portland in 1934 on a permanent basis, it was as a Junior Forester."

At that time the Bureau of Entomology was establishing sample plots in the pine region to evaluate trends and mortality from beetle attacks. Could you describe that work?

"Yeah. Of course, that had been going on for quite some time. Paul Keen had established these plots in California and southern Oregon. After I came here, this was extended into Washington. So this was a comprehensive program in which half-section plots...half-square mile plots...were established, and we followed the trend of western pine beetle infestation on these by measuring tree mortality annually. I think it was a good measure of trends, and, by modifying it in a rather subjective way, not a mathematical way, I think that it was a fair measure of the losses that were sustained over very large areas."

A bit earlier than this, 1931, the hemlock looper epidemic finally started slowing down because of airplane dusting of the area according to Bob Cowlin. Was there a residual effect of the hemlock looper when you got there?

"Well, the hemlock looper is one of these defoliating insects that has a relatively short cycle. The effect is very severe, within a very short period of time, and then the decline, due to natural factors, largely virus and, to some extent, parasites, is very abrupt. The theory of control is that, if you jump in there and apply control before one of these outbreaks peaks out, you avoid the bulk of the loss, even though it's only applied once. In the outbreak in Pacific County...this is all by reading reports and talking with Beal and Keen and (W. J.) Buckhorn, who were the people involved in it...this was the first aerial application in the western United States. There had been one in B.C. a short time before, but this was successful on the acres treated, it was very, very successful on that. It was applied late in the game and they still got quite a bit of loss on untreated areas. But the importance of this, I think, was more in the practicality of aerial spraying more than it was in the actual (control)."

Who was responsible for the introduction of the airplane in treating insects?

"Well, the first (aerial) treatment was in Stanley Park in Vancouver, B.C., and the Hoppings (Ralph and George) were the ones. In the case of Pacific County, Washington, I'm

not sure...you'd have to go to the principals as to who and how this developed. I'm sure that Keen was involved, that he knew about the success in Vancouver. He had Buckhorn available, who himself was a flier, very enthusiastic about the use of airplanes, and he had the Weyerhaeuser people there again, a very aggressive forest protection man in the case of Major Cowin, who was familiar with airplanes in the military sense. So it all kind of jelled together. Now, who the catalyst was, I don't know."

In 1936 Keen developed his theory of classifying ponderosa pines based upon the plots that had been laid out earlier?

"Yes, the trend plots had various uses. He looked at the Dunning tree classification and concluded that this classification didn't suit his needs and perhaps even silviculturists' needs, so he looked at other types and concluded the stand really could be broken down into four age groups and four vigor groups.[5] The vigor groups had to do with position in the stand (dominance), and other things. By recording which of these tree classes were killed on these sample plots, the risk could be assigned to these different classes based on mortality experience. So one tree class might be ten times as susceptible or likely to be infested as another class."

A lot of very innovative discoveries and theories came out of the Northwest, this being one. Was it because of the individuals, or was it due to the social climate in this area, because of the importance of lumbering?

"Well, I think it was both of these things. I think the individuals were certainly very important, and the urgency of getting solutions (was economically motivated). Industry was at the root of it. Most of the lumbering at that time was on private lands...in fact, there was pressure on the Forest Service to withhold timber from sale at that time. But I think it goes back to individuals, and I don't really like this regionalization thing, because many of the origins of these theories were pooled efforts. Actually, Keen came from California. He happened to arrive here with some pretty well-formulated ideas to which people like Miller, particularly Miller, had contributed. Miller was really a grand old man, very accomplished. I think that this was a pooling of effort."

Back to your story, then. You went to Portland for awhile...

"Just for the field season. I was loaned, you might say to Beal's project."

Because of your experience with slash (U-1). Then you went back to California. How long did you stay this time?

"Until I was transferred to Portland in 1934."

What were you working on when you went back to California?

"Well, diverse things...mostly bark beetle problems. For example, one of the things was the chemical injection of trees to prevent attack or to control insects already attacking. This was a thing that was developed in the Southeast. Craighead and others were interested in tree injection. In the case of sugar pine in California, it seemed as though this was an ideal thing

[5] Keen, F. P. 1943. Journal of Forestry 41:249-253.

because the bark beetles began attacking high in the tree, and they might produce a brood one year and then come down the next year and maybe kill the tree the third year, so it looked like this was an ideal opportunity to inject toxic chemicals, into the trees and prevent mortality. Well, there are a lot of angles to this, but that was one of the projects. It was not successful partly because we couldn't get the chemicals up into those tremendous (tall) trees."

Okay, now, trying to get back into the stream of the interview. In 1934 you went to Portland permanently:

'That's right."

And what was your role there?

"Oh, I guess in those days the Bureau did everything. When there was a need, you filled in. It was still mostly, work on the pine beetle. I was an assistant to Keen...Beal left for Colorado, and in essence I took Beal s position here and worked on the projects as they came up. We were responsible for surveys, and we got involved in control, helping the Park Service and the Forest Service and whatever. I was very much interested in the insect collection, for example. I had been for a long, long time, both at Berkeley and here. The record keeping of many different kinds of insects, the Hopkins System, which you've probably heard about, was a system whereby records, biological records, were kept on a great many different kinds of insects, and they were tied in with insect specimens. These were kept in cabinets and you had the records and all that sort of thing. It became very useful when an insect would develop into an economic problem. You had information acquired over a period of time about an insect, although you didn't know whether it was going to become important or not. Sometimes it did, many times it didn't.

"So I was responsible for the collection, building it up, and, many other kinds of activities that came up. We had not been very much involved in defoliator projects. The hemlock looper was the principal one. But then, as we became aware that there were defoliator problems such as the blackheaded budworm and the spruce budworm for example."

What were the main projects that were going on in the latter part of the 1930's that you were involved in?

"I would say the bark beetle work. We did many different things relating to this. We conducted studies on the effect of low winter temperatures (21); I was involved in a couple of these up here (U-7). We made these studies, one of which was related to a very early (seasonally) occurrence of low temperature; another was related to a very intensive low temperature. We put out thermometers in the woods, then went out in the dead of winter and collected this stuff and related the temperatures to aspect and elevation, rather detailed studies of the effects of temperature and what you could expect in the way of bark beetle kill following certain temperatures. But we found that winter mortality had a short term effect. As long as the trees were susceptible, the generations build up very quickly.

"In those days, a good deal of our field work was spent on surveys, of sample plots. We'd spend pretty much of the summer inventorying these plots. Buckhorn was in charge of the mechanics of it. At that time surveys were a function of the research activity, and we did it very largely on the basis of sample plots. Then, during the winter months, reports would be prepared and submitted to the agencies or the private companies.

"As time went along, we became aware that there were many other insects besides bark beetles that we weren't giving any particular attention to, and, since we had a flier, Buckhorn, who was interested in the use of airplanes, together, I guess, we devised the concept of aerial surveys of this area. First, we got flights with whomever we could, sometimes the Marines, sometimes the Coast Guard, sometimes, well, everything. The survey was done by an aerial observer with a map. And you have to fly low. So we developed this concept, and by that time Keen had gone down to California and I was in charge. That was in the 1940's. Gradually this concept of regional surveys was developed. A lot of things were happening in this period, the Pest Action Council..."

Could you describe the Pest Action Council a bit, how it was formed, and its function?

'The Pest Action Council developed in the early stages of the spruce budworm control program. I suspect that what we should do would be to talk about spruce budworm first."

Okay, I have a couple other questions. First, you mention Buckhorn being a flier and working at the Station. But I ye heard he was something of a character, a popular man. Could you describe him a little bit?

"Well, that's a pretty hard thing to do. Buck was, I suspect, the most colorful individual the Bureau ever had in the West with the possible exception of some of these early ones that (H. E.) Burke described.[6] Buck was a fabulous character, one of these people that are naturally endowed with observational quality and skills of many kinds. He was not formally schooled. I forgot where he peeled off, but he had very little schooling. But he had a way of expression; he could convey his ideas very, very well. In this skill of observation he was ingenious, he was an inventor in a way, he invented a lot of things we used. Mechanically, he kept our equipment in shape. He could fly, fact is, he was a stunt flier, wing-walker and that kind of stuff. Just, just fabulous. A fellow to really be admired. He had a little philosophy with his crews he took into the woods. I'll always remember that he instructed his crew, "always leave the camp in a little better shape than when you found it." I think this illustrates his concept of things, his public responsibility."

Then, on flying, too, in the interview that Woody Maunder did with Ralph Hall, he talks about your brother, Mal, and his early efforts at aerial reconnaissance and it just didn't work out (air sick). Could you go into a little about your brother's career?

"Well, really not. I was never very closely associated with his career. I know that he went to Forestry School at U. Calif. (Berkeley). This is no indication of a lack of appreciation of Mal, because we're quite close, but I don't feel that I can explain his career in any way. Then somehow or other he got interested in entomology. His work in California, I was not intimately familiar with that. I know more about what he's doing in Idaho. I've collaborated with him on some papers (19), but I don't feel that I could give you a real good picture of this."

OK, let's go on to the budworms. then.

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[6] Burke, H. E. 1946. My recollections of the first years in forest entomology. Berkeley, Calif. June 28. 37p. (illus.) [Processed].

"Well, we became aware of spruce budworm activity in the eastern part of the state, and noted that infestations flared up and dropped out. No study was made, just recorded as having occurred. Finally, there was an outbreak that covered many hundreds of thousands of acres. When DDT became available and aerial application seemed possible, we didn't know whether it would be effective against the spruce budworm. So a project was set up on the Umatilla National Forest in 1948. Beal came out from Duke U. and Charley Eaton from the Berkeley California Lab. We set up an experiment. It worked (18).

"Different types of ownerships were involved in the big outbreak. At that time the Pest Action Council movement was developed--Ernie Kolbe and Bill Hagenstein of the industry and Oscar Erikson of the Forest Service Timber Management and other key people and the regional forester, Hoss Andrews, who was a key man. I would say that the two principal people were Kolbe and Andrews. They conceived the idea of a cooperative approach. At first it wasn't the Pest Action Council, it was the Spruce Budworm Committee, or some such thing. Gradually this became the Pest Action Council movement. The account by Professor McKinley of Reed College on this subject, plus a publication or two by Kolbe, will give you the factual history.

"Gradually, the Northwest Forest Pest Action Council developed and spread to other areas in the west--California, B.C., Northern Rocky Mountains and Intermountain Region, and finally to the east coast. This approach, considering the pest problem from all angles (administrator, researcher, and the public) judging its merits and what the alternatives are, and then doing the next step of getting the support of the administrators, and appropriations from the legislature, were all things that this council movement took on. We operated by consensus and then we got into the fact that, well, we don't have enough information, we need more research. The Pest Action Council undoubtedly was very instrumental, influential, in the establishment of facilities and programs such as the Forestry Sciences Laboratory at Corvallis. I would say that this is a very significant development. It took it out of the hands of, well, it expanded the program into a truly cooperative, volunteer type of approach, as contrasted with an authoritarian, governmental type of thing. We had our own forum where we could disagree. If there was no consensus, this was a red flag indicating that maybe there isn't the preponderance of evidence necessary for a particular course of action."

I'd like to get into a little more on the history of dusting and spraying.

"Well, dusting went out with the hemlock looper project in the thirties. From then on, it was spraying. Our first experience with spraying DDT was in Clatsop County, Oregon, against the hemlock looper. During the war years there was a severe local outbreak of the hemlock looper, principally on Crown Zellerbach land. Trees of all ages were being killed over a considerable area, and it occurred to us that about the only thing that could be done to save this timber would be to aerially spray it. Calcium arsenate dust had been applied previously against the hemlock looper in Pacific County, Washington, in the early thirties. But this material was expensive to apply and created some problems. The people of the city of Seaside were very reluctant to have arsenic sprayed on their watershed. They had heard about DDT, which the Army was using for insect control in the South Pacific and other places, and suggested that we try to get some of this material released for our use on the city of Seaside watershed. We agreed to approach the Army on this, and were successful in getting this material. We did use a little lead arsenate on some adjacent areas, but on the main watershed, they wouldn't agree to this.

So we did get the material released for the watershed. This is rather significant in these days in which DDT and water just don't mix.

"Anyway, this was our experience with DDT, and it was very effective against the hemlock looper. And so, when the spruce budworm outbreak began to develop to very severe proportions, we thought of testing DDT, which by that time was available in quantity and there had been some experience with it in other parts of the country."

Did you think, at the time, that this was the safest way to go? Did you have any idea that there would be negative results from the use of DDT?

"No, we were aware that this material was among the safest insecticides available, so far as mammalian toxicity is concerned, and it still is. But we were not aware of some of the side effects on aquatic life. We knew that it was highly toxic to insects, but we had no real basis for being concerned about the environmental effects at that time. So we conducted an experiment that proved highly effective against the spruce budworm, and we sprayed large areas, principally in Oregon, it totaled millions of acres. The spraying was done mostly in the Blue Mountains, and on Mt. Hood National Forest and, to some extent, the Willamette National Forest facing into the Willamette Valley. We started with fairly small airplanes and then got up into larger things like the DC-3 and the Ford trimotors."

Did you ever acquire your own planes for this operation?

"Not for forest spraying. This was all on contract, and these projects sometimes were administered by either the Forest Service or the state depending upon which the predominant ownership was. If it were state and private, the state of Oregon would administer. If it were largely national forest, then the National Forest Administration would be responsible. Being an agency of the U.S. government, the Forest Service had to accept the lowest bid. This proved disastrous one year in which the Forest Service, had accepted a bid from an obviously, in our opinion, unqualified contractor. As a result of this, several pilots were killed due to improper equipment or the operators took chances. Subsequently, precautions were taken and bidders were screened more carefully, and we didn't have this type of experience again."

Was the DDT very effective against the budworm?

"Yes, very much so. And, as a sidelight, the Canadians were having severe trouble with spruce budworm in eastern Canada. At that time, we thought that the spruce budworm was one single species from east to west, and it subsequently developed that we had six or more species of budworm of this type, some of which are destructive and some are not.

"In eastern Canada, in the balsam fir and spruce forests, which are utilized by the pulp and paper industry, they had these very severe outbreaks. Traditionally, what happened there was that essentially the whole forest was killed and then regenerated, over and over. But they were dependent upon this standing timber so they were searching for ways to do something about it. And there were different opinions as to whether anything could be done or not. A group of the Canadian forest entomologists, Dick Rice, (R. E.) Balch and (M. L.) Prebble met with John Woods, Jr., who was assistant state forester of Oregon and one or two others of us in Banff. We told them about our experience. They were convinced that this was the way to go. Subsequently they sprayed many millions of acres, more by far than we had ever sprayed, upward of twenty million acres. I could go into this. Their area is different in that it's almost

unbroken forest and very difficult to come to the edge of timber, so they had a problem of where to quit spraying. They had trouble with re-infestation from the surrounding areas."

What was done, once it was discovered that there were actually s different species of spruce budworm?

"In the West it was recognized that there were certain areas of certain species where, even though they flared up and were feeding on the foliage, there was no point, really, in spraying because they weren't truly destructive. Incidentally, our concept of forest spraying is not preventive, as in agriculture, but to apply control at the point where massive losses would otherwise occur. In other words, take the risk up to a given point.

"There's another concept of control, and that is to stamp out the spots wherever they may occur. The only trouble with that is that we get local outbreaks all over the place all the time, and if you do this, you're going to, in the long run, spray much more timber many more times than you are if you let the natural controls operate."

In the long run, do you think it was worth it?

"Well, I think so, in that the timber was protected. It developed that we did have some fish-kill recorded, and there were undoubtedly some detrimental effects, but the amount of timber that was saved and subsequently, much of it, harvested, I think was well worth the effort. I think that judicious use of pesticides in the forest is really an essential to the economic production of wood fiber. I feel this strongly. I don't feel that any great mistake was made in deciding to use DDT.

"Later, when it became evident that there were side effects, drastic side effects and detrimental effects, on the environment, there was quite an effort made to get alternatives. And there was a great emphasis put on the matter of permanence. DDT was considered to be bad because it is long-lasting. The opposite was taken as a good effect, that is, if it is short-lasting, it is good. It wasn't always realized that a short-lived insecticide can be even worse. For example, the urge to use phosphamidon on the subsequent hemlock looper outbreak. This is among the most toxic materials you can possibly use. In this case, we almost lost a pilot due to nominal exposure to the chemical, and finally it was decided, somewhat arbitrarily, not to use this. And they had a similar experience in Canada. In other words, permanence is not the issue. It has to do with the specific role of that insecticide. The proper use of material relates to the material and the problem at hand, just like the use of pharmaceuticals in medicine. Almost all of these are extremely toxic materials used in improper ways. Used properly, they can achieve the result that you are striving for. Even with those, of course, there is a degree of hazard, almost anything you do has a degree of hazard connected with it.

"The spruce budworm project carried on for a number of years,[7] to the point where the outbreak was controlled largely, I think, as a result of our spraying, and to some extent by natural factors, mainly parasites, in this case.

[7] Whiteside, J. M. 1956. Spruce budworm control in Oregon and Washington, 1949-1956. Proc. Tenth International Congress of Entomology, Montreal, Canada, Aug. 17-25, 1956.

"In the Lake states there was a proposal, to control spruce budworm through manipulation of the forest by cutting to create differing age classes and so forth. In the West, however, the spruce budworm, seemed to attack all ages of trees, and we didn't seem to have this possible approach."

Was there ever any attempt to introduce parasites into the area?

"If there was introduction, it was very minimal. The spruce budworm has a very large complex of parasites; they are quite similar both in the east and west. There wouldn't be any theoretical advantage in importing from another area the type you already have here. So this avenue, with this insect, was never really thought of as a possibility."

When was spraying first done in Oregon with DDT?

"It's my recollection that the experimentation was in 1948 (14) and first spraying in 1949. Subsequently we were much involved in aerial spraying of the tussock moth in the West. I think that really the person to talk with about this program would be Ken Wright, who was Assistant Director of the PNW Experiment Station. He's currently director of the coordinated tussock moth program. We were involved in it both here and in Oregon, and jointly with the people in Idaho in 1947."

Can you tell me about the regional surveys in the Northwest?

"Well, yes, they started out, as we said a little while back, with the pine beetle survey plots. Forest by forest, there were estimates of the annual losses or kills on national forests, Indian reservations, and private lands. And then as time went along, we became aware of the continuing influences...effects of things like defoliators. It became evident that we needed a means of locating these outbreaks, and particularly after we had a means of combating by aerial spraying. So, how to do this? We had Buckhorn, who was a flier, and very much interested in the use of airplanes. So for a period of time we contracted airplanes and got them from different sources and began to cover more and more of the two states. By that time, the Pest Action Council was in operation and so this information was gathered on maps and presented to their annual meeting, which had representatives of the various agencies and owners. We could point out where the problems lay and then the organizations could do what they felt should be done.

"Well, then it became evident that we needed our own equipment, that contracting was not sufficient, so in 1947 we recruited a young man, a former Navy flier, John (F.) Wear, who had taken his forestry training at the University of Michigan. And we got a surplus plane, I've forgotten whether it was an army or navy trainer, and he flew it out, and we used that airplane on the annual survey. John had specialized in aerial photography, so we became interested in aerial photography and the possibility of using this in our aerial surveys. But much of the aerial surveys were by an observer in the airplane. He would plot the location of the outbreak and determine symptomatically what insect might have caused the damage. Then we would check it on the ground to verify the causal insect. People like Buckhorn and others became very confident at it. I tried my hand at it a number of times. It was fun. I saw a lot of country. This developed into a routine thing and was adopted rather generally in other regions. The eastern people under Wear's counterpart, Bob Heller, were the first to really use aerial photography and they contributed otherwise to development of aerial surveys. Now, all the regions of the West conduct annual aerial surveys of forest insect damage. There are many different instruction

manuals. Buckhorn had a good bark beetle survey manual, a very fine one. At a point in the fifties (actually, July 1, 1961), the survey responsibility passed from research personnel in the Experiment Stations to personnel in National Forest Administration."

Did it suffer some then?

"Well, I don't know that it suffered. It probably became more efficient as far as the physical nature of it is concerned. Earlier, I expressed my reservations about wedding research with (resource) administration, because you have the possible conflict of interest between management policy, and, you might say, the scientific part of it. As you recall, at one time the forest insect activity was in a different Bureau and at that time treated a private timber owner, the national forest, the Parks, the Indians, anybody, just on the basis of the merits of whatever the problem was. You weren't associated under a chief higher-up somewhere, well aware that there are certain policies. So this is one of the significant changes from the earlier time."

This happened at the point when the Forest Service took over?

"Afterward. We had many lively discussions on this subject."

Didn't you go to Fort Collins?

"Yeah, this was kind of an interim activity. I was assigned to take over the Fort Collins laboratory (replacing J. A. Beal), and moved over there in the spring of 1940. Then, shortly after we got there, we got word that, I was up in the Black Hills at the time, they were going to close the Station. Well, this was kind of a startling piece of advice, and so I went back to Fort Collins and asked what it was all about. Lee Strong was Chief of the Bureau of Entomology at that time and was convinced that when you get short of money, instead of just retrenching, you cut out activities to show the impact of the cut.

"Good strategy, but in that instance, they picked the area that had the weakest political support, almost all federal land. If they really wanted to show impact, it should have been in Berkeley or Portland or some other place like this, but they picked the area that was weakest politically and they cut it out. Everybody at Ft. Collins was cut off. Miller and Keen came to the rescue and salvaged the personnel (e.g., N. D. Wygant went to Berkeley), all except Dwight Hester, who was in surveys, and he went to National Forest Administration because he had previously been a forest ranger."

Were you in charge at Fort Collins at that time?

"Yeah, of forest insect investigations. I was stationed there at the Forest Experiment Station."

You were actually independent, weren't you?

"Yeah. Charley Cahn (Station Director) did all he could, and other people did, too. Anyway, when we got back to Portland he (Strong) said, "Well, now we've closed the Station, but we want you to cover the problems on a commute basis." This was most of Wyoming, Colorado, and Utah, New Mexico, Arizona, a few other fragments, parts of Nevada. Do this on a commute basis (laughter). I saw a lot of country. There was a project going on in the Uinta Mountains, Utah which is in the extreme north, sloping over into Wyoming. There was another down on the southernmost forest in Utah (Dixie N.F.). I would commute overnight between

these two control projects so I'd be on the job the next morning (laughter). It was a very, very interesting experience. I commuted for two seasons. We got around and saw a lot of things, and my recollection is it was during this period that the spruce beetle outbreak in Colorado was generating. I may be in error on that, but it was right about that time that the tremendous thing was building up."

What else did you do after you came back to Portland?

"I set up a field laboratory at Pack Forest, which is the University of Washington's experimental forest just to the west of Mt. Rainier. We studied a variety of insects: wood products insects, carpenter ants, ambrosia beetles, and a little weevil that attacks the young Douglas fir (*Cylindrocopturas furnissi*) (5), which is still a problem.

"I started a study on flat-headed borers (*Buprestis aurulenta* and *B. langi*) that bore in seasoned wood. In the forest, they lay their eggs in downed timber, dead timber, and also newly sawn lumber, and therefore get into houses. And they will also lay their eggs in exposed lumber that is unpainted. Well, our interest was in the fact that these are reported to be quite long-lived. There are instances on record that would indicate that they live 20 to 50 years, from the egg to the adult stage. But this was circumstantial, in other words, a board was shipped to Britain, or someplace, and, since this insect is not native to Britain, it comes out and is alive and since the board can be identified as a Douglas-fir board that came over in a certain year, the assumption is that the borer must have been in the board all that time. There are a lot of examples of this circumstantial evidence. But in Pack Forest in those early years I got them to lay eggs and developed a method of maintaining larvae in blocks, and I still have some *B. aurulenta* in the basement. At least a few are alive [continued by M. Furniss at Moscow, ID after 1980]. We've got some in this house. They came from timber that was cut in the 1933 Tillamook Burn. They're just a nuisance; if they come out through a wall in the living room, it creates a little excitement. But that's about all. We caught live female adults and then induced them to lay eggs. When the eggs hatched, about a month later, we cut a little notch in each experimental block and put a, larva in it and sealed it. They just go in and live there, happily, I guess, for a long time[8] None has emerged yet under the indoor (dry) conditions that they have been kept since 1939-1941.

So it could be that they do stay in the larva stage for fifty years.[9] Isn't that quite unusual in insects?

"Yeah. There are a few that do this, but I believe that this is the longest-lived one on record."(!)

Are there other important insects that reach epidemic levels in this region?

"Yes, I think of two specifically that are very damaging at times and one that is of potential importance. The damaging ones are the Douglas-fir bark beetle, and the balsam woolly aphid. The potentially damaging one is the European pine shoot moth.

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[8] Furniss, R. L 1962. Longevity of two species of *Buprestis* Ann. Meeting, Entomological Soc. Amer. Phoenix, AZ, Dec. 3-6.

[9] One block opened in 1985 contained a live larva, 46 years old (MMF).

"The Douglas-fir beetle occurs wherever Douglas fir occurs. It's perhaps most destructive in the inland form of Douglas fir. At least, it occurs in epidemic numbers there more frequently. In the so-called Douglas-fir region, the wet belt of northwestern California, western Oregon, Washington, British Columbia, it occurs only occasionally and then only in connection with, you might say, catastrophes. Very large fires and extensive blow-down, both of which provide large amounts of breeding material, dead trees. The bark beetle jumps on these, builds up in large numbers, flies out (a year later), and attacks and kills the nearby green trees. Then, in a very short time, due to the resistance of green (live) trees in this area, the population drops off very quickly, so quickly that there would be no practical way of applying direct control to reduce the loss. So in this case, it's primarily a problem of identifying the dead trees and salvaging them as quickly as possible. We've had a number of such outbreaks.

"Perhaps the principal ones, undoubtedly the principal ones, were in connection with the Tillamook Burn (1), a very large burn (1933) in which there were vast amounts of green timber killed around the edges of that burn, and that added to the problem of salvage. As a matter of fact, most of these trees were not salvaged because of the tremendous amount of trees available for salvage in the burn itself. The other catastrophe that I'm thinking of was the blow-down (and ice storm) in which a very large amount of timber was blown-down (1949-1952) in western Oregon, principally. As a result of this, (Douglas-fir beetles) built up in very large numbers. So we had the combined problem of salvaging wind-thrown timber and beetle-killed timber. In this case, an aerial survey was conducted, as has been reported in detail. I'd recommend that you consult this written record (20). The point is that here's an insect that aggravates catastrophes such as I mentioned. The approach, in this case, is salvage." (RLF also studied rate of deterioration of Douglas-fir killed by the burn (22)).

What about the balsam woolly aphid (adelgid)?

"Oh, yes, this is a very interesting insect. It is a European insect that has somehow been introduced into the West. It attacks most of the true firs, some much more than others. It's particularly destructive to grand fir, Pacific silver fir, less so to noble fir and some others. We had an outbreak of this insect in south central Washington, again on Weyerhaeuser land principally, but also on national forest land. It was very, very destructive, and was spreading both north and south. We had no way to control this insect. So there again it's a matter of salvage. The Weyerhaeuser lands were largely salvaged.

"Then, as it spread north and south, it got into the subalpine fir stands and it's very destructive there. These are the firs around the meadows and in the scenic areas in the high mountain country. As it went through there, it was killing literally one hundred percent of the stand. The concern was that it would cause great damage in places like Mt. Rainier Park. It did get into the Park, but fir is a relatively small component of those stands so it didn't cause much mortality. But elsewhere it did. And then it got into British Columbia where fir is very important. They applied quarantines and restrictions on the movement of fir. It's rather interesting that, after a certain point, this insect seemed to subside naturally. I have some ideas on why it subsided but the best source of information would be Russ (R. G.) Mitchell, who has studied this both in this country and in Europe. He's at the Forestry Sciences Laboratory in Corvallis (subsequently at Bend). There was a very interesting photographic survey of damage caused by this insect (referred to report). In Europe, of course, it's not much concern. It may be, I'm theorizing here, that somehow or other the trees build up an immunity to it."

What about the pine shoot moth?

‘The pine shoot moth is another introduced insect. It came in on nursery stock. It is well established in the east and had been quite destructive in the Lake States. We were very much concerned that it might be very serious in the relatively dry sites of the ponderosa pine region. The evidence was that it does well under similar conditions. Well, it was found established in certain places in Washington State.

“We recorded this and made it known to the Pest Action Council. A number of people on the Council, of course, represented pine interests, private, federal, and state. They were very much concerned about the possibility of getting the moth in there, so they thought about the matter and decided to try to exterminate it in the residential areas and the nurseries, and try by quarantine to keep it out of the ponderosa pine region. The Pest Action Council was influential in getting state action, Canadian cooperation, and all the rest of the things that were necessary. At that time, we had no absolute assurance that we could treat nursery pine stock, to get rid of the shoot moth, and have the pine stock survive. But we experimented with methyl bromide fumigation and it proved successful but very touchy to apply because the plant is sensitive to the treatment. It is an example of a foreign insect corning in and you had to speculate on what the impact would be, had to take appropriate action on your best judgment, because if you waited to see what it would do, then you’d have an entirely different situation and you’d have to meet that. So they did this, and I think the quarantine was fairly effective for a period of time.

“Gradually, it broke out of quarantine and by that time, enough experimentation had been done with the insect, actually under controlled (caged) conditions, in the pine region to convince most of us that the potential hazard was not as great as we had originally thought. I don’t know exactly what the present situation is but I think some quarantines are still in effect. But now it’s viewed less seriously than it was before because we know more about its possibilities in the pine region. At that time we had no experience.”

The interview ended at this point.

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