AN INTERVIEW WITH
JOHN C. WELKER

by

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Introduction

John C. Welker earned a bachelor of science degree in forest management from Auburn University in 1970. While working on a master's degree in forest science and economics at Yale University, he volunteered to spend a summer at Daniel Ludwig's huge forest plantation along Brazil's Jari River, as part of his overall education. He wound up getting paid--to him a bonus on top of the incredible experience--and he returned to New Haven and completed his degree in 1972. Shortly he was back in Brazil as manager of forest management planning for Jari Florestal e Agropecuaria, as Ludwig's enterprise was officially called.

Just think of the challenge--and opportunity--that the fresh-out-of-school Welker faced. One-quarter of a million acres of native forest was in the process of being replaced with plantations. The three species of trees planted--gmelina, pine, and eucalyptus--either were not natural to the equator or little was known about them. To that add the training of an indigenous work force and the development of a town and overall transportation infrastructure in a remote part of the world. All of the pieces had to mesh to produce adequate fiber to feed a pulp mill that would be installed. The plans had to work!

John's responsibilities expanded in 1978 when he became manager of forest operations. Now he would coordinate forestry with logging in line with the needs of the pulp mill, sawmill, and the wood energy plant. In 1983 he left Jari and returned to graduate school, this time at North Carolina State University where he earned a Ph.D. in economics and forest management in 1987. Since then, he has been employed by Mead Coated Board in Phenix City, Alabama.

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Harold K. Steen (HKS): Let's talk about your background, to see what sort of skills look good when you were hired for the Jari project. You went to Auburn, majored in forestry. Why forestry?

John C. Welker (JCW): My father graduated from Penn State in forest management a little after World War II. He went into landscape architecture, but he always said that if he had it to do over again, he'd still major in forestry and become a landscape architect.

HKS: Sure

JCW: I guess it was his influence. I didn't want to go into landscape architecture. I didn't want to deal with people that much.

HKS: But you didn't have anything specific in mind. You wanted to work overseas, or something?

JCW: I did have something specific. I guess probably in high school, I really kind of became interested in economic development and in helping people. This idea evolved while I was an undergraduate, of the interrelationship of how forestry might play into economic development in countries because of the rural nature of forestry.

HKS: O.K.

JCW: When I was at Auburn, I did my senior project on the *ejido* system in Mexico and how it would relate to forestry, that land use pattern. I guess that was my idealistic reason for getting into forestry also.

HKS: Did you know when you were at Auburn that you were going to go on to Yale?

JCW: I was like most students. My time horizon was fairly short. But I did have a sense that I wanted to go into something to help people in probably third world countries. But I didn't know about where I was going, if I was going to go to graduate school or not.

HKS: But you went directly from Auburn to Yale.

JCW: I did.

HKS: And you got a degree in forestry and economics?

JCW: I took courses in the economics department at Yale, and then also took, mainly, sort of mensuration classes at Yale. George Furnival, for example; I guess I got the most out of some of his classes in growth and yield.

HKS: Your master's program was nearing an end, you were looking for a job, I assume. You weren't thinking about a Ph.D. at that time?

JCW: Between my first and second year at Yale, a Ph.D. was sort of on my mind, but I really said to myself, I want to go out and get some experience before I work on my Ph.D., and get some more guidance. Between my first and second year at Yale, I was interested in getting a job overseas. I was coming out ahead on my fellowship at Yale, because I was working in a place called the Geselle Institute for Child Development. They had had a long-term relationship with Yale forestry students of providing their room free for seven hours of work. So I was getting my housing free when I was at Yale, and so I was saving some money.

I wanted to take that money I was saving and go abroad between my first and second year, to get some experience. I think I applied for a job in Trinidad and Tobago, and I got a letter back saying that it was too short a time, and so forth. I was actually offering my services for free, as long as I could get the experience. I talked to Dick Porterfield, who was working on his Ph.D. at the same time I was there. Dick said, Well, I've got a friend who's in this project down in Brazil. His name was Don Cole. And you might write Don. So I wrote Don Cole saying I'd offer my services for free and so forth. This was pretty late in the game. This was, say, January or February of '71. I got this letter back from somebody else--it was Clayton Posey who sent me a letter back--and saying they would accept the offer.

HKS: Were you interviewed?

JCW: No, I wasn't interviewed. I was given the name of somebody in New York, a Rose Gomes to talk to in New York City. I went and talked to her and got a physical, maybe. Now I'm not even sure about that. But anyway, I talked to her about making the travel arrangements. But what happened was that when I got down there it turned out that I never met Don Cole, because he had been--I don't know if he was fired or released or something. He was no longer there when I got down there. So I met this fellow named Clayton Posey at the airport. He happened to be on the same plane.

HKS: Now you were hired, you'd accepted the job?

JCW: This was just for the summer.

HKS: Oh, just for the summer. O.K.

JCW: I just wanted to get some experience between my first and second year at Yale. Clayton said at the time, he said that I could take a plane ride, I could wait till Thursday--I think we got in on Monday--I could take, I could wait till Thursday and take a plane, or if I wanted to, the next day I could take a boat, which took about forty-eight hours to get up to the project. I said, I'll take the boat, that sounds good, by myself. You know, I didn't speak any Portuguese. Now, I'd had four years of Spanish in high school, most of which I'd forgotten.

HKS: O.K.

JCW: But that was a real experience, because I really got myself immersed that first forty-eight hours. Also knowing how us foresters think, he, Clayton, was probably testing me. He was probably seeing what I could take or not.

HKS: He said a thing in our interview with him about how much better the boat was than flying.

JCW: Maybe that was it, too.

HKS: I don't know if this is philosophical or what.

JCW: I don't know. The boat has its drawbacks too. You'd have these rats going around on the floors. But anyway, so that's the way I got there. I worked that summer; the project they put me on was making volume tables for *Gmelina arborea*, which was the species at the time. I went out with a crew of one person, and we would fell a tree and measure tree sections, and basically made a set of volume tables during that summer. At the end of the summer, they paid me for working, plus they paid my way down and back, which I said I would do. I came out "smelling like a rose" on that deal. Subsequently, after I graduated from Yale, I asked them if they were looking for anybody, and I applied for a job. They accepted my offer, and so that's when I started to work for Jari in 1972.

Life At Jari

HKS: Were you married?

JCW: No, I was not.

HKS: O.K. That made it easier in that sense. Without getting too personal, you can answer as specifically as you want, but were the compensation and fringe benefits, was the financial package--after you graduated--at Jari attractive as opposed to working elsewhere? You could go to Alaska and drill for oil, you make double or triple wages for two years or something. Was that an issue?

JCW: No, it wasn't an issue. I couldn't even answer that question from the standpoint that I didn't make any comparisons. If we go back to my motivation, which was primarily to work and see the relationship between forestry and economic development in countries, I mean, this was just an ideal situation. You might have even looked at it, probably the way I perceived it subconsciously, as just an extension of my education.

HKS: O.K.

JCW: I wasn't married, I was young. My utility function, as an economist would say, was modest. The pecuniary motives weren't really there. I was more interested in the experience. So I couldn't even tell you how the compensation compared.

HKS: I talked to Bob Gilvary maybe three weeks ago, and he was saying he was hired as an engineer at exactly the same wage as he was making for the state of Pennsylvania. That surprised me, because Jari could be perceived as a hardship outpost. And so you'd up the ante a little bit. But apparently that wasn't Ludwig's style. We'll talk about Ludwig as we go along, I'm sure. I don't know who set those

standards, whether Clayton had that kind of influence, or they all came out of the New York office.

JCW: I don't know. It may have been that Clayton or whoever it was was a pretty good wage negotiator, too, for that matter. I don't know.

HKS: Yeah. So, well, I want to ask these questions to get it on the record, just so we understand what the Jari experience really was. Did you look at it as an opportunity for advancement? You've sort of answered that already--no, this was a continuation of your education.

JCW: Education.

HKS: But if you stayed there for awhile, what were the benefits, other than feeling good about yourself?

JCW: The experience.

HKS: The experience.

JCW: Coming at it from the perspective of somebody interested in forestry and economic development--here was a situation where you were basically three hundred miles, or it was probably more than that, to the nearest metropolitan area, in the middle of the jungle. You were basically using forestry as a tool to foster economic development, starting at the ground floor from growing trees all the way up. So I think the experience. That was what was in it for me.

HKS: Did you pay rent for the place you lived in, or was that part of the compensation?

JCW: No, that was part of the compensation. When you comment about what wage rates were, the fact that we didn't pay rent and also, when I went there, didn't pay for my food either, as I recall, or if I did pay, it was so nominal that it was not any real deduction from one's net pay.

HKS: O.K.

JCW: So, that was a good deal. Your saving rate could be very high, because there wasn't anyplace to spend money. All there was was a company grocery store. We ate in the company mess hall, and if all your meals were provided, what were you going to spend your money on? Nothing. So, it was a good savings rate.

HKS: I realize it may have changed over the years as the infrastructure developed. Was there a liquor store? Were there bars? Were there those sorts of things? I've read about hospitals and schools, but were there...

JCW: I'm basically a teetotaler. It seems to me that there wasn't much in the first years. No, there wasn't much. When people would come to visit the project, they would bring in duty-free type stuff. You could buy stuff in Belém, in *cachaça* rum. That was all freely available, the Brazilian liquor, and spirits, and so forth.

HKS: I guess it was pretty impressive by the time that you left, in a lot of ways, with hospitals, and schools, and playgrounds, and whatever.

JCW: Yes.

HKS: But since you were single, you might not have paid as much attention to that as you would had you been married.

JCW: From the eleven years that I was there, you could certainly see differences. And I was married two years after I got there; I started paying attention to those things more. When we first got there, across the river there were just a couple of houses occupied by local folks. The economy had been where the people would go out and collect Brazil nuts, and pelts, and that sort of thing, and trade them for staple commodities like sugar and things like that with the local land baron or whatever. Then Mr. Ludwig came in and established a landing strip near the river, which eventually moved up to the plateau (*planalto*) area, put in some company houses and the company mess hall. That was basically it, with the supermarket. That was the only place you had to buy anything, this one supermarket. The commerce on the other side of the river--even though Mr. Ludwig owned the land--was in the federal territory of Amapá. He stayed off that side of the river for a number of years. So the local shacks and houses and commercial activity there developed before we had a bigger supermarket in Monte Dourado, the town.

HKS: Was Monte Dourado already established? That was the place, obviously, where the town was going to be developed by the time you got there. Those decisions had all been made--

JCW: Yes. In '71 it had already been called Monte Dourado. In fact, they had already moved the airport. I guess the first airport, back in '67 or whenever, had been right where one of the streets is in the town of Monte Dourado today.

HKS: The AAA map I brought down to show has South America, and Monte Dourado is on the map. It became a real place.

JCW: Yes. That's right.

HKS: Gilvary pointed out, or observed, that it was in the wrong location. It should have been built where the pulp mill was, because you had to transport all the labor eighteen kilometers.

JCW: I guess what Bob is saying, it would have been better to have the labor closer to the mill, from that perspective. On the other hand, the advantage of having that town away from the mill is it's a more amenable place to live rather than being right near a factory facility.

HKS: I see.

JCW: In fact, now the kaolin mine and the factory for doing the kaolin processing is near the pulp mill. They've got a small town or villa right near the pulp mill. I was

down there about three months ago, for the first time in several years, and I wouldn't want to live in that little village. I would rather live up in Monte Dourado. From the standpoint of industrial facilities, yes, I agree with Bob. It was far away. But from the standpoint of living, it was good that it was located farther away from the pulp mill.

HKS: By the time you were married, two years after you got there, there was housing for married couples?

JCW: Yes. There was housing for married couples when I got there, too.

HKS: Describe your house.

JCW: I may still have the original plans. Bob Gilvary designed this, by the way. It was a T-shaped house, where you had bedrooms at the top of the T, two bedrooms. You had a bathroom in the center, you had a living room in the top part of the base of the T, and then at the bottom of the T, you had your kitchen and the washroom. It was made out of wood, probably Brazil nut wood, and the windows were not glass windows. They were jalouse-typed windows with screens, and then you could close the wooden jalouse part of them to keep the dust or the rain out.

HKS: Louvers.

JCW: Louvers, not jalouse. Louvers.

HKS: O.K.

JCW: Each of the louvers was about four inches wide. You would close them by hand, and so you had the experience that you were almost camping out, because when it rained, the humidity was just tremendous in the house. But then that was kind of the bad thing about it, the mildew problem. The good thing was that you had this nice sense of air throughout the house. We had an air conditioner in our bedroom, which was nice for the hottest days, but at night it was fairly comfortable without an air conditioner, because things cooled off quite a bit when the sun went down. We did have twelve hours of night, you know, because we were right on the equator, so there was plenty of cooling effect. When it got hot was, say, at noon time, and particularly in the dry season when you didn't have a rain, that kind of cooled things off. There was a tile floor. It was very adequate and comfortable. You can maybe have an opportunity to talk to my wife, and you can get a different perspective. [both laugh]

HKS: The relations between engineering and forestry when you arrived. Who was running the show when you got there?

JCW: When I was there in '71 the director was a fellow named Clyde Jernigan.

HKS: Clayton said the mistakes that were made were because they tried to grow trees by engineering standards. They used heavy equipment--

JCW: I see what you're saying.

HKS: There's a transition period.

JCW: By the time I got there, foresters were running the show. I think the oldest plantations we had were gmelina plantations established up on the plateau in 1967. That was a kind of an engineering approach. They went up there with bulldozers. It was a very crude concept from a forestry perspective.

Mr. Ludwig found this tree, by one of his persons that went out and did these sorts of things in Africa. It was actually a tree native to India and Southeast Asia. This fellow that Mr. Ludwig had going around, saw this tree growing in Africa for pit props. And it grew very quickly. He got some seeds. Bring the seeds over to Brazil, clear off an area with tractors, plant them, presto! You got a big tree! I mean, that was the concept. We recognize in forestry that soil is a very important component of growing trees in that environment. And that was not recognized in the engineering approach. To answer your question, it was a forestry directed program by the time I got on board.

HKS: Clayton had been there several years. He was hired as a geneticist.

JCW: Yes.

HKS: But he obviously had moved beyond that rather quickly.

JCW: Clayton, it seems to me, got there in '70 or certainly '71. And, like I said, he came down on the plane with me.

HKS: Who else was there, as you can remember? I have names. Clayton, of course, Bob Gilvary, because he was there almost at the beginning. Johan Zweede. Who else were the players at that time?

JCW: A fellow named Djama Chaves was a soil scientist. He was there in '71, and then he was there in '72. He left in about '72 to work on his Ph.D. at the University of Maine, with the idea that he would come back, but for various reasons which I never completely understood, he didn't come back. He subsequently went to work for Westvaco, their outfit down in southern Brazil, on research. Oh, let me see. The other names of some Brazilian folks--several Brazilian foresters. Gilberto Barbosa, Carlos Saraiva, they were out of the School of Forestry at the Federal University in Viçoza.

HKS: Were most of the technical people that worked at your level U.S.?

JCW: If you're referring to technical in terms of mensurational, growth and yield kind, yes. I would say so. Staff sort of things. If you're referring to foresters and forest management, they were typically Brazilians. Djama Chaves was a very technical person. He was Brazilian and had gotten his degree there in Brazil and then went on to the University of Maine.

HKS: What help did the company give you to learn Portuguese?

JCW: They didn't really give me any help. I didn't ask for any help. As I mentioned to you, I'd had four years of Spanish starting in the seventh grade and went through the

tenth grade, but I'd forgotten a lot of it. But the good thing was, I remembered enough of it that I really knew the structure. The syntax in Portuguese and Spanish are very similar. There's a lot of confusion, though, and differences in some words. Well, I'd forgotten enough of my Spanish that it didn't get me confused when I learned Portuguese.

HKS: O.K.

JCW: But it really helped me in terms of grammar, in terms of learning syntax and conjugation. That was always one of the problems with people who had Spanish as their primary language, who'd come from other Latin American countries--because for many of them it was very difficult for them to make the transition. They would mix up Spanish and Portuguese words.

HKS: How fluent did you have to be to be effective, to do your job? Could you carry on conversations, or just give instructions?

JCW: It's like communication anywhere. The better you are at communicating, whether it be in the same language or whether it be in the other language, the better, more effective you're going to be. I always felt it was just essential to learn Portuguese. I guess it's because I tend to be, as you can probably tell from this interview, a pretty verbal person, and so I think it's important to be able to talk. I enjoy learning a new language and getting some of the nuances between one language and another, the way things are expressed.

HKS: Were there night classes?

JCW: I didn't take any. I know some people were offered classes. Some of the people that came down, particularly some of the engineering people that might have been down there for a shorter period of time. And some other people had the Berlitz tapes, and so forth. The people that I hired subsequently, I would just recommend to them to get a good grammar book and to immerse themselves in the language. For example, on that first boat ride, where I had a lot of fun back in '71, I was there with a lot of folks who were basically just laborers going out there to work. It was really fun because we had that bond. I carried a notebook around, and I would draw a picture of something and ask them, How do you say this? And they would say. And we just had fun learning it. Always my recommendation was, to the people that I hired, use the language as a way to establish relationships. Here's one of the things that the people, the local folks, know better than you know. And that will make them feel good, too. They know something you don't know.

HKS: Sure. Clayton made a point how important it was to learn the language, that he would fire people if they didn't learn the language after six months or something.

JCW: Several people commented to me in my presence that I was, I probably learned the language faster than most Americans that came down there. They always kind of used me as an example, that even somebody as stupid as I can learn the language.

HKS: [laughs] I don't know how similar Brazilian Portuguese is to the kind they speak in Portugal.

JCW: There's a difference between northern Brazil and southern Brazil, too, quite a bit. But it's similar enough that you can understand one another. In Portugal it's a lot heavier accent. During the time of the Angolan civil war, there was some recruiting done in Angola and Mozambique, and we had some of those expatriate Portuguese come to the project. And that's where I noted some of the differences.

HKS: Sure.

JCW: Another person was Don Haight. He was an engineer, I guess, in charge of equipment and things. He did a lot of things, for example, the rice project. He did some of the major civil engineering type of work down there. Another person, Fred Garci. He was in charge of the warehouse. He might have been a Mexican American or a naturalized American citizen from Mexico.

Daniel Ludwig

HKS: How many times did you talk to Ludwig himself?

JCW: I think I only personally talked to Ludwig maybe two times the whole time I was on the project. I want to say it was towards the end of Ludwig's involvement with the project. They asked me to take him on a field trip and show him some things, and I did. And I can't remember a lot from the field trip, you know. It's always the case where you're sitting there talking to somebody with a very high authority and you don't know quite what to say. It really is up to that person to say a lot to you. But I think we went out and looked at some gmelina plantations and so forth.

HKS: The descriptions of him in various kinds of media, *Fortune* magazine and whatever, describe him as a tall man. And yet there's a photograph of him with Ronald Reagan, and Reagan is a good six inches taller. Do you have any--

JCW: I don't remember him as particularly tall.

HKS: O.K.

JCW: As he got older, he stooped over a little bit like most people.

HKS: And he had that back injury, too I guess.

JCW: Yeah, that's right. Yeah. But, you know, he wasn't particularly tall that I remember.

HKS: So you don't have a sense of a dynamic personality or a tough minded person.

JCW: I do have a sense, I think, of a fairly tough minded personality. I'd been in some meetings where Ludwig was there, you know, and I was just an observer, a bystander.

HKS: O.K. I'm fascinated with Ludwig because all of the accounts, except maybe the one that you coauthored in the *Journal of Forestry*, are critical of Ludwig, of his

vanities, he didn't like the press. You begin to feel that one of the reasons there are so many negative articles about Jari is that people wanted him to fail. I don't know. I'm curious. I have no insight at all about whether it was good or bad, and I want to talk about that as we go along. But it's incredible, when you read the twenty or thirty articles I have, that the guy was a nut. Jungle madness, on and on and on. You're the third person now I've talked to who actually knew him, and you don't describe him as a nut. His disdain towards academics, his short temper, and all.

JCW: I think he probably did have a temper. I think he probably got frustrated a lot. But I can't say I knew him enough personally to know what his character traits were. My perception of him is, as I say, he's a doer. He was a person who had amassed a large amount of wealth by going with some gut feelings after World War II, in terms of the oil tanker business, and so forth. Like most of us, he was a product of his own successes and his own failures in life. I've described his simplistic concepts of how to go about developing plantations in the tropics, which over time had to be informed with some forestry opinion and forestry expertise. But still, he had that basic idea that we need to move on and get things done quickly, because I want to see this stuff before I die. I want to see the fruits of my labors. If you think about it, you would say, well, if he really wanted to see the fruits of his labors, maybe he shouldn't have thought of forestry as where to do it. What was always told to me by Clayton Posey and others, was that Ludwig's basic vision behind why he wanted to do this in Brazil, in forestry, was he thought there was going to be a worldwide fiber shortage in the 1980s.

HKS: O.K.

JCW: His desire was to go in and step in and create fast growing plantations and help solve that. Well, first of all, there wasn't a worldwide fiber shortage in the 1980s. But secondly, forestry, even if you've got short growing plantations, is still a long-term investment, because there's a learning curve you go through. I don't believe that Mr. Ludwig appreciated the type of learning curve you need to go through in an agricultural crop in a new environment. I think that's where the frustration came in, and maybe some people were very critical of him, and to some extent rightly so, in not recognizing that nature of a forestry investment. But on the other hand, where I respect the man is his ability as a man of action, to be willing to take his assets that he had earned and, with a hunch or whatever, to go forward with that hunch and put his money where his mouth is and not waffle. So I have to respect that to some extent. While the fruits of the Jari investment might not be measured strictly in terms of ROTC (return on total capital), if you measured up solely on those terms, it would be a failure. But if you could measure those fruits in terms of learning, in terms of developing a town and a pioneering type venture, I basically on the whole think the guy has to be admired for doing that. I think in the long term, a lot of those short-term things like return on capital and stuff will be forgotten. It's a bigger issue than just that in the scope of history.

HKS: You've already said you didn't remember very much about what happened. But when you took him on this field trip, did he seem to be learning, or was he dissatisfied by what he was seeing? The trees weren't growing fast enough, or what's...?

JCW: When I first got down there, Mr. Ludwig would come fairly frequently down to the project, let's say once every four months or so. As time went on, those trips

became more infrequent, probably in part due to his back problems, probably in part due to some other business things, and probably in part due to some of his frustrations with the project, eventually leading to his pulling out. When I met with him, it was towards the latter part of this. He was down there for one of those infrequent visits, and I'm sure he had a lot of things on his mind. So what I remember was that he was pretty much preoccupied with other things. Even though they wanted me to take him out and show him the gmelina plantation.

Typical Day

HKS: Describe a typical day. How did you know what needed doing? What kind of a plan was there?

JCW: I had several job responsibilities over the total time. So let me talk about, let's say, 1972, '73, '74, during that period. My initial job responsibility was to set up a continuous plantation inventory system with the objective of not only knowing the inventory of how much wood we had out there, and how fast the trees were growing, but to be able to project forward, create yield tables, project volume forward in time. As part of that, setting up the continuous plantation inventory system in the first years, I basically had three people working. I had one person who was Marcos Braga, a forestry technician I think from Santa Marta. Basically a two-year agricultural school technician. By the way, Marcos later became a logging contractor. So he became an entrepreneur in his own right.

The other one was a fellow I think named Cristovam, who probably had a sixth grade education. That was my work crew. I set up the sampling design for this plot system, and we would go out and measure the trees. One of the real advantages was that I got a real feel for what the trees were doing in the ground, because I had visited every one of these plots. Now later on we had more and more plots, and my job changed. I didn't get out in the field as much, but I really got a sense of what was happening on the land base.

So my typical day would be--let's see, I think we started work at seven o'clock in the morning, and we finished up at five o'clock in the afternoon. We'd get in the pickup truck and go out and measure plots and trees. At the time we didn't have personal computers, and all that. In fact, one of the big deals was where to do the data processing. Later on we worked out an arrangement with Oklahoma State University, where we actually did our data processing up there. Gradually we did that in Brazil, as we got some other computing resources.

I'd start work at seven o'clock or seven-thirty and usually eat at six o'clock at the company mess hall. For lunch you'd generally eat out in the field. There were some camps for the laborers out there where you'd have black beans and rice. Then you'd come in and you'd eat in the mess hall at night. That was during my bachelor years, from '72 to '74.

HKS: So you had a routine.

JCW: That's right. On Saturday we worked from seven-thirty to ten-thirty, although we typically worked longer than that. You've got an environment where there's nothing to do except work and sleep, and of course you did have social activities with the other families or whatever, but work was pretty much a part of your life.

HKS: Gilvary said he went hunting every weekend. I don't know if he meant that literally or not. That's a lot of weekends.

JCW: Oh, he meant it literally. [laughs]

HKS: What did you do during your leisure time?

JCW: I read, and I liked to go hiking. I went fishing. I remember there was a fellow named Jairo. He was a mechanic, a Caterpillar mechanic. Brazilian. And I went fishing with him several times.

HKS: Who did you report to?

JCW: I initially reported to Clayton, and then later on I reported to Charles Briscoe. Initially, there was just Forest Management. That was the period I reported to either Clayton or to Charles Briscoe. Then when we started gearing up for harvesting, we developed Forest Operations. Under Forest Operations you'd have Harvesting and you'd have Forest Management. I reported to Briscoe for awhile in that, but then eventually I reported to Johan Zweede, who was responsible for Forest Operations. That was basically the person I reported to until I left the project, Johan Zweede in Forest Operations.

HKS: O.K. Who did you supervise? Were they mainly Brazilian technicians?

JCW: I had at maximum two expatriates work for me at a time. We would look for an expatriate with respect to biometrics and statistics. One of the problems was in the Brazilian forestry schools, there wasn't a very good supply of people who were foresters who had good enough knowledge of statistics and biometrics, quantitative aspects of forestry.

HKS: O.K.

JCW: Initially those were the sort of people I would hire from the United States. Forest economists, statisticians, biometricians. As time went on, the Brazilian schools started graduating persons proficient in those fields. Going back several months ago and visiting again, I think there are certainly very qualified Brazilian foresters, just as qualified as they are in the U.S. right now. It's really nice to see the Brazilian educational system come up to world class standards in terms of producing foresters for the type of forestry that is practiced there.

HKS: It must be some sort of a market response. There were jobs for those kinds of students, and so they were able to...

JCW: Industrial forestry has really come a long way. In fact, I think Brazil in terms of industrial forestry, plantation forestry, is in many respects ahead of the U.S. right now.

HKS: Clayton talked a lot about this, and I could tell he was a bit bitter by the general reaction of the outside world. He didn't think much of the--he called them the propeller type scientists from the U.S, the professors who'd come down for two weeks and then come back and write an article about it. There was very little publishing that came out of Jari at the time.

JCW: Yes.

HKS: Was it something that you observed too?

JCW: We had some frustration with people who would come down, and maybe it had to do with the persons when they visited, their motives. You always have this thing when the journalists come down, what you think their motives are. As you have more experience with journalists you get a little more wise to things. But whether it be a journalist or whether it be a scientist, forestry is, like most biological sciences, an applied field where it's very important to be close to the project at hand and to learn the problem. Just like Mr. Ludwig made the mistake of thinking that you could plant these trees and they would grow.

I think that scientists, armchair scientists, particularly ones new to their work, can make the mistake to think they can fly into a situation and in twenty-four hours, or a very short period of time, really understand what's going on. I was also frustrated sometimes when people would come with their own preconceptions and leave with those same preconceptions without listening and not being there a long enough period of time to really understand the problem. The problem is that they really weren't there long enough to understand the problem. O.K. Now I think some other frustration would be that the objective function or the motivations behind the people were different; it was just a difference of opinion. I mean, it's not that one person was right and the other person was wrong, but people just had a philosophical difference of opinion of the way things ought to be.

HKS: O.K.

JCW: We just had different opinions. As we reacted to what people would say in the press about the Jari project, it was just a difference of opinion. For example, is the Jari project a model for development in the Amazon? I can make a case and say, Yes, it is a model, because you're trying to, on a smaller piece of land, go to intensive management so you can preserve land elsewhere. Other people can make the case and say, No, it's not a good example, because we need to preserve the entire Amazon.

HKS: O.K.

JCW: But it's just a difference of opinion. So I think there was some frustration perhaps on all our parts when people didn't see things the way we particularly saw them.

HKS: But you didn't feel compelled to publish in the *Journal of Forestry* or other outlets.

JCW: When I was describing my typical day--we were so focused towards our work. Maybe it was Mr. Ludwig rubbing off on us [laughs], but we were so focused; we would be given objectives--to get so many acres planted, or here this pulp mill's going to start in 1980 or 1981. Those were the things we had to get done. We didn't see our role down there was to necessarily publish, at least initially, to publish our results. Later on, we became more outgoing in trying to publish some things.

The other part is the physical remoteness of our project. When I first went down there, there was only one plane a week, or maybe it was two times a week, and one boat a week. As time went on you'd have maybe one plane a day. That doesn't lead itself to publishing or contact with the outside world. I particularly know now in my present job, when you can pick up a phone and talk to somebody, or you can get on the Internet, that leads to a kind of interchange. So I guess there were two reasons we might not have published. One is because we had other goals in mind, and secondly because we were isolated, and it wasn't in our work objectives to publish necessarily. But I will say one thing I think we did. Even though we didn't publish, I think we did a pretty good job of maintaining archives of what was done there. We had an office fire in 1980 or '81 that burned a lot of records. There was a lot of information about Jari there, if people wanted to dig deep to know what was done.

HKS: That brings me to another general question. Do you have photos, reports, and so forth, that you brought back?

JCW: I have some personal photos and stuff, yes.

HKS: In something, one of the articles that you sent me, one of your footnotes cited *Jari Florestal e Agropecuaria*. That's the latest experiments, inventories, and forest operation plans. Is that set of documents in the States?

JCW: I worked there from 1970, well the summer of '71 and '72 through '81 I worked for the company that Mr. Ludwig owned. The company was bought by a consortium of companies, of which the principal one was a company called CAEMI. And I worked for the new company for about a year, a year and a half. Prior to the ownership going over totally to CAEMI, for those records that were owned by the old company, or some of the records--we took some copies of things as a historical archive, and we sent those up to Syracuse. In fact, I went up to Syracuse with those records, because they expressed an interest that they would take care of them. I don't know what subsequently happened, because that was not a funded project. it was basically something we went and did.

HKS: The only thing I found in Syracuse doesn't sound like what you're talking about. Very, very technical studies.

JCW: There was also some inventory information. Computer tape, some wood samples. This is just a piece of it, of what we sent. These were the research stuff, some of the technical studies, right. I have no firsthand observation for this, but I have a sense just from kind of general things, since this was an unfunded project (and this is not to make any disparaging remarks about the people in Syracuse) and because the

way universities work, people put their concentration where the money is. And academic folks have, just like everybody else, busy schedules. I have a feeling that the material remained in the original boxes and was not archived from a historian's perspective. It may still physically be there, but it's been kind of going to the four winds.

HKS: Why was Syracuse selected? Did it make sense?

JCW: At the time, and maybe still, Syracuse had had a program in tropical forestry, particularly on the wood tech side of it. There was a set of wood samples. So that was the main reason it was selected.

Ron Woessner was in charge of the research department. Johan Zweede, who was the forest operations manager, was the person that kind of said, We need to have some sort of record so a lot of the stuff isn't lost. And so Johan talked to Ron, and he talked to me from the inventory standpoint. Ron left; sometime before we handed the stuff over to Syracuse, Ron got a job in the States. And so I was the one who wound up going up to Syracuse and handing over these boxes and explaining the contents to Dr. Alan Drew.

Applied Research

JCW: During the break, you were commenting about how Bob Gilvary referred to some of the sort of micromanagement. He may not have used that term, but some of the sort of things that Mr. Ludwig did with respect to engineering. In forestry--maybe in the beginning it was a little bit of micromanagement in the sense of the idea of, we're going to select this tree species.

HKS: O.K.

JCW: I mean, that would be micromanagement from the standpoint of that's an important decision which shouldn't be taken lightly. You should do studies and all this. And so Mr. Ludwig micromanaged in that instance. Another kind of example was the decision to grow pine trees. Clayton Posey probably told you that Mr. Ludwig didn't want to grow pine trees.

HKS: That's right.

JCW: Clayton went ahead and planted some pines back in 1970 without Mr. Ludwig's knowledge, on an experimental basis, and then showed Mr. Ludwig this later. That was what brought us to eventually plant pine trees beginning in 1973. I think as time went on, as Mr. Ludwig probably recognized he was out of his depth and out of his field, he kind of left us alone with respect--us meaning forestry--alone with respect to micromanagement. Now he didn't leave us alone in terms of questions like, you're going to plant this many acres. Which again could be interpreted as micromanagement, because you probably need to put that through a little more sophisticated model, as to how many acres you should plant. But he didn't get down to the micromanagement about how you should do your nursery or anything like that in forestry, which

apparently he did with respect to equipment decisions with the engineering side of things.

HKS: Ludwig would see the forecast, you're going to need so many cubic meters of wood, you go so many cubic meters per acre. I don't know where he would have gotten ideas that he needed to clear more land, other than obviously you'd have to clear more land if you're going to have plantations.

JCW: I wasn't in on a lot of those conversations as to how many acres to plant exactly. Clayton was more involved with that than I was. I don't know how he goes about that. Another person to talk about Mr. Ludwig's characteristics would be Don Haight. I don't know where Don is now. He may be back in Oregon. After leaving Jari he spent a number of years overseas for different companies selling equipment and managing various projects. I don't think he's a university graduate, but he's the school of hard knocks and experience, coming from a civil engineering background. He and Mr. Ludwig, as I recall, had kind of a special relationship. Whereas Bob Gilvary is an engineer from a university background, and certainly did a lot of things with engineering, Don had the experience from a field engineer builder type standpoint. So a lot of times he, Mr. Ludwig, would talk to Don--I know, because I knew Don pretty well. I think Don would probably have some fairly unique perspectives on Mr. Ludwig.

HKS: How did you know how to do things? Like, when you did your yield tables. My perception is, and I may be wrong right off the bat, that it wasn't a well known process to do yield tables for young plantations. The tree has to be a certain diameter before it has any volume. What models did you have? How did you know how to do that?

JCW: The kind of theoretical models that I used were the models from the literature for pine plantations and for other things. You know, kind of the basic equation forms. But you're right. You have to change your perspective in terms of the information--what information you have to build those models with, or to use those models with. There's some real advantages in the tropics, in the Jari situation, because your information comes in quite a bit quicker. Whereas with, say, loblolly pine, on a twenty year rotation, you probably have to wait till it gets to be at least twelve years of age to start really getting any kind of information about yield. With gmelina, which peaks out its mean annual increment at about six or seven years--at least in our conditions it did--at about three years of age you start to see some definite trends. That means you could put an experiment in, and if the experiments were well located, you could start getting some feel. In fact, I would say our problem in yield projection with gmelina was not the yield projection for a given site, although we had some initial problems with that, but really knowing how many acres we had of those sites. And knowing the right site classification. That was really our yield projection problem, because gmelina turned out to be a very site specific, site sensitive species for the soils that we had at Jari. And for that reason probably it was not a good choice for the long run, and subsequently has been basically abandoned as a species.

HKS: Gmelina in other areas, like Costa Rica and Africa, you didn't have that--the site issue wasn't--

JCW: Apparently they have better soils. In fact some of our initial volume information that Mr. Ludwig had about gmelina--and I guess I've sort of described earlier this kind of real naive approach. I should say, to give him credit, that Mr. Ludwig had some land in Costa Rica, I think, and Panama--maybe just Panama, where he established some plantations, a plantation or experimental plots of gmelina. And so he had some knowledge of gmelina's growth. But it seems like that was established, say, in '66, so it was almost done at the same time the Jari project was set up. But to get to your point about sites--we had soils which were a lot more variable, I believe, and a lot less appropriate for gmelina as a species than Costa Rica, where apparently Stone Container Inc. is using gmelina right now. I haven't visited those plantations, but I think they've had some success there in growing gmelina.

HKS: The point I'm trying to get at here, the point of how isolated you are. You didn't have a major technical library.

JCW: We didn't have, for example, anything to go to for gmelina yield tables. We had to build our yield tables from scratch. You could find in the literature some things about gmelina, but it was more of a botanical nature or about silvics of the tree. It wasn't about growth and yield. Later on when we approached the problem with *Pinus caribaea hondurensis*, which was the other species that we developed, we had a little more to go on because that species was being grown in Fiji and some other equatorial regions. So we could get a little more out of the literature from that. But with gmelina we were really starting from scratch.

HKS: What access did you have to literature? These days you can go online, onto the Internet and you can dial things up.

JCW: We had a weekly pouch from the States, but we didn't have anybody really in the States that we could say, do a literature search in the library. So typically what I and some others would do when we were in the States on vacation would be to go to a library and spend some time. I can't remember when it started, I want to say in 1972-73, we established this relationship at Oklahoma State using their computer center. We had a fellow named J. L. Albert that worked at Oklahoma State, and he did the processing of our growth and yield, our plot data. When I was up there, I would look in the library and I would do some interlibrary loan and that sort of thing, do some literature searches. Another source was Oxford, I mean in the sense that *Forestry Abstracts* being more of an international type thing, and because of the British influence in Africa, that would be a place you could find a little bit of stuff on gmelina, for example.

HKS: I've been told that the largest tropical forestry library in the western hemisphere is the Forest Service library in Puerto Rico. Did you make any use of that library?

JCW: No, we didn't. No.

HKS: So you would go back to a forestry school in the States that was convenient.

JCW: I would tend to look in *Forestry Abstracts*, which of course covered whatever had been published. You'd look for a species. This all seems so antiquated compared to

today's search techniques. But anyway, *Forestry Abstracts* was one of the key literature search tools.

HKS: That's something you actually received by mail. You had it right there in Jari.

JCW: We developed our own little library there at Jari, which subsequently burned up in our office fire, but Charles Briscoe had worked in Puerto Rico, for example, with the U.S. Forest Service, so he had a tropical forestry background. And one of the things he was instrumental in doing was to try to set up the library there at Jari. So we accumulated books over time about various aspects of tropical forestry.

HKS: Clayton said that he had more people in research than he had in line work, at one time, in the forestry side. He didn't define what research was, but apparently it was a major aspect of the effort, because there wasn't knowledge.

JCW: That's right.

HKS: You had some empirical observations--well, this must be something like other species--you could draw upon...

JCW: Yes.

HKS: How about consultants? Did you bring in soil specialists or botanists? I'm not sure what kind of specialists you'd need to do the job.

The Problem with Gmelina

JCW: We had specialists come in from time to time. When Mr. Ludwig would apply for loans, you would have to have consultants come in for the agency loaning the money to do some things. So you'd get consultants that way. We had a fellow named Ian Bailey, who was a subcontractor with Reid Collins. He was from England, came in as a soil person. We had Harold Burkhart and Zeb White who came in one time and looked at growth and yield. Frank Bennett, too. There were some kind of negotiations with Weyerhaeuser. And we had two fellows, Alex Goedhart, who was out of Weyerhaeuser out of Chehalis, Washington, and the other fellow that I can't remember. They lived there for about six months. I wouldn't describe them so much as consultants as much as, they were there to try to learn what was going on. And they'd also do some consulting and give some advice, too. The other person I remember is, Charles Hodges came in. He was a pathologist in the Forest Service. When we were looking at *ceratocystis*, which is a disease for gmelina--

HKS: The chancre--

JCW: The chancre disease, yeah.

HKS: I wanted to ask you about that, because there's disagreement whether that chancre was really serious, and the paper that you wrote says that it was.

JCW: O.K.

HKS: But Clayton said that when gmelina was under stress, it had a problem, like any other species, under stress. But it was growing well. The chancre was no more of a problem than it would be for any other species. That may not be the way he said it, but.... I'd asked him the question because Fernside and Rankin wrote those series of articles. As a matter of fact, you cited them in the articles you wrote.

JCW: Yes.

HKS: I assume that you find them to be respectable scholarship.

JCW: No, I don't.

HKS: Oh, you don't.

JCW: No. No.

HKS: O.K. Well, I was citing them to Clayton, and he disagreed--

JCW: I don't know whether they're respectable scholarship--with respect to the Jari project, I have differences of opinion, of the way we see the world. And that's just the way people are. We see things differently. I also have differences of opinion scientifically with them. In other words, the interpretation they give to some facts about Jari, some articles I've read, I don't agree with. I don't think they're right, correct factually. Now I can't remember exactly what that is. So that's--to say that I don't agree with them as scholars, I haven't read all their articles, so I couldn't say. Judy Rankin, she came and visited. She asked me some questions, and we talked. A couple of years later, I saw this article, and it was as if we had not been with the same person interviewing.

HKS: I see.

JCW: I thought they took more of a journalistic approach to things. When I say a journalistic approach--getting back to one of these questions you'd asked me about what Clayton thought--I think they came to the Jari project with some preconceived notions. They had a hypothesis and they were looking for facts to support that hypothesis. As a scientist, it's all right to come in with a working hypothesis, but you have to take those facts which will support plus those facts that don't support that hypothesis.

HKS: Absolutely.

JCW: And I believe that there's a tendency in some of the stuff I've seen for them to disregard the facts that don't support their hypothesis and only accept those that support their hypothesis. If my perception's correct, I don't agree with them. Oh, the chancre disease.

HKS: The chancre. He said it was a serious problem.

JCW: I would agree with him on that.

HKS: O.K.

JCW: I can't remember the exact year that the chancre disease surfaced as a real management issue for us. This is a disease that's on cacao. It's a native, it's an endemic disease with cacao. It has a pretty large range, or the potential to have a large range. The scientific name at the time, they may have changed it, was *Ceratocystis fimbriata*. But with gmelina, to counter what Clayton is saying about stress, we had some of our biggest problems with the chancre disease on the best soils, in other words, on the terra roxa soils. Where it really got its start, at least my working hypothesis of where it got its start on our trees, was when we had a pruning program--

HKS: O.K.

JCW: Charles Hodges would be the person to talk to about the scientific aspects of this disease. But it comes in on pruning scars. Now subsequently where it would come in was in the coppice management of gmelina. We weren't really wed to coppice management, because you can't capture genetic gains with coppice management. But when you cut the gmelina it does sprout back profusely. In fact, that was one of the problems--how do you kill this stuff so you can put in your second generation? Or, if you want to convert to another species, how do you get rid of the gmelina to plant pine trees? Because it's hard to kill with the herbicides we had.

But anyway, with that coppice management there, you got this nice, nice area for the spores to get into. And actually I had, from our growth and yield plots, our continuous plantation inventory plots, we started recording for every tree whether it had *ceratocystis* or not. And I worked up a matrix, a transition matrix. Like if a tree has the evidence of it, what's the probability it will die in the next year.

HKS: Sure.

JCW: One of the things that became very alarming and one of the reasons we started really shifting more aggressively looking at eucalyptus as a species in the latter years was that those transition matrices were saying that our mean annual increments would start peaking earlier and at a lower rate. I would say it had a really significant effect, that and soils. The other problem with gmelina of course, as I said, is its yield goes down tremendously with poorer soils. I think gmelina probably has a place at Jari, if the management wanted to continue it with the genetic testing. But the question you have industrially is, do you want to bother with it?

HKS: Sure.

JCW: In other words, this is a cost. You're going to have to improve it.

HKS: Chancre may not be a good example, but I'll use it for lack of specific knowledge.

JCW: Sure, that's fine.

HKS: You go out one day and you see something. You have a general forestry background, you're certainly not trained in pathology. And you see this thing.

JCW: O.K.

HKS: And you don't know if it's serious or not. And you probably saw lots of things, most of which turned out not to be serious. Where was the expertise that you would draw upon? Would you bring in a pathologist?

JCW: That's where you'd bring in a Charles Hodges, for example. In fact, Charles Hodges was brought in. We had had Charles Hodges and Charles Briscoe, who had known each other in the Forest Service.

Eucalyptus

JCW: Let me talk a little bit about eucalyptus. We had research plots with eucalyptus going back to 1970. *Saligna* and *grandis* and so forth. In retrospect some people might ask, Why didn't you plant eucalyptus? Everybody else in Brazil was doing it. They're doing it right now at the Jari project. We started planting it. One of the things that scared us with those eucalyptus plots was that they had a chancre disease. Not *ceratocystis*, but another one.

HKS: O.K.

JCW: By the way, Brazil has been able to conquer that disease by looking for the right genotypes, the right species, that are resistant to that. Probably in retrospect I would say we should have pursued that more vigorously in our genetic programs; eucalyptus is an important species in Brazil, and we're in the Amazon. Everybody else is really not in the Amazon. They're in subtropical regions. Now I think *Eucalyptus urograndis* and some others are successful, and those genotypes are being developed at Jari. They're getting very good yields there, which are, I think, going to be competitive with the rest of Brazil. Now we did adopt a strategy back in 1979, where we started doing eucalyptus species trials, looking for other species. On that basis we looked at *Eucalyptus deglupta*, which is resistant to that chancre. It is one of the true tropical eucalypts, not the subtropical but true tropical. We actually started planting *Eucalyptus deglupta* on a wide scale as a way to sort of meet some fiber shortfall problems because of the gmelina problem.

HKS: The literature on eucalyptus was probably pretty hefty.

JCW: Yes. That's right. The thing about our situation at Jari--if you look at the bands on the earth of where successful plantation projects are, they're not on the equator.

HKS: Right.

JCW: Aracruz, for example, is often cited as a very successful project in Brazil. That's really not in our zone. That's a totally different zone, different rainfall patterns and

everything. There are not a lot of projects right on the equator. And eucalyptus is really a subtropical species, on the whole, more than it's a tropical species. Now as I say, Jari is having success with some of the subtropical eucalyptus species. But that's largely due to genetic testing and finding those genotypes within that species that can do well.

While I'm on this digression about genotypes, with respect to pine, the current project, right now, they're weaning themselves away from pine. I think there's tremendous potential for developing pine as a tropical species, but only with a lot of genetic testing, because if you look at the plantations, there's a lot of variability that can be captured. Now whether Jari or any other company wants to capture that, if that's a good business decision, that's another point. I'm digressing a lot here.

HKS: No, you're not.

JCW: If I was to look at two keys for setting up industrial plantations, it would be to pay attention to soils and pay attention to genotype. And to use, manipulate those two resources to your greatest advantage.

HKS: Well, Clayton, the boss man, was a geneticist.

JCW: Yes.

HKS: And he must have been more sensitive to this than the typical manager would have been.

JCW: Yes.

HKS: But even then, it still wasn't enough. Looking back you see there should have been more done.

JCW: The thing that I keep going back to--and I think Clayton would probably mention this and probably did mention it in his interview--it's getting back to the character of Mr. Ludwig and his time frame versus the time frame of forestry research. Even though forestry research can go a lot quicker in the tropics, it couldn't go as fast as Mr. Ludwig wanted to go. At Jari it couldn't go as fast as it could be in other parts of Brazil or Australia or wherever, because we didn't have the literature on gmelina like there was on eucalyptus in the subtropics. So we had to go faster and try to do some things right from the start. So we had kind of two strikes against us, in terms of a learning curve. One is, we weren't given a lot of time to learn. And secondly, we had not as steep a learning curve because we had to do a lot of it ourselves, rather than get it from the literature and from what previous researchers had done.

HKS: Has enough been published on the gmelina experience that, should someone else want to try it, they could build on?

JCW: I don't know if enough has been published, because I haven't been in that literature. But there certainly is enough experience now, if you take the Jari experience, and there was some stuff published on that. Maybe not a lot. We did articles in the *Journal of Forestry*, but that really wasn't about gmelina itself.

HKS: And IUFRO presentations.

JCW: And IUFRO.

HKS: Usually they're not very technical, because you have an audience who barely understands the language you're using.

JCW: In terms of experience with gmelina, I think there's enough experience out there that's being carried on, whether based on Jari or based on what they're doing in Costa Rica.

HKS: At the time this was happening, gmelina was seen as sort of the wonder tree. You could do everything but eat it.

JCW: Yes.

Lessons from Jari

HKS: Can you generalize from the Jari experience? If another Ludwig comes along and wants to do something, would there be a cookbook that could apply in Indonesia or somewhere else?

JCW: I don't think it would be a cookbook. I think that there's some things that someone can learn. A lot of aspects of Jari were so unique, kind of one at a time type things, that I don't know what you could get from that, for benchmarking for future projects.

HKS: A lot of the critics of Jari, and there's a lot of those comparing it to Henry Ford because, mainly because there were billionaires behind both.

JCW: That's right.

HKS: Well, Ford couldn't buy nature, and Jari, Ludwig's not going to buy nature either. Nature's going to win. And look what happened to Ford.

JCW: Sure.

HKS: According to Clayton, there was a knowledge of what Ford did, and he said it really wasn't comparable, the problem was that the genetic base of his rubber plantation was far too narrow, and it would have been wiped out anyway, or some such thing.

JCW: I don't know enough about that. I do remember hearing of the comparison in the popular literature, newspaper articles. Will this be another Fordlandia, that kind of a spin on things. But I don't really know enough about what really happened at Fordlandia, whether it was economic or biological or a combination of the two.

HKS: There was a disease that wiped out the rubber trees.

JCW: O.K.

HKS: It grows O.K. naturally, but in plantation.

JCW: With respect to forestry development, I guess the key learnings I would have is, you need time. You need a good research program. We had a lot of people devoted towards research. But I think you need a little more time than we had. If Jari had been a stockholding company, you would have taken a lot longer time to make some of your strategic decisions. I've heard people counter and say, Well, if it had been a stockholding company, Jari never would have happened, because the risk would have been too high for any stockholding company. You'd have to give Ludwig credit for being far-reaching, because even though there wasn't a fiber crisis in the 1980s, there was a need for more fiber. I was at a recent RISI conference, for example, and what they're pointing out, there's plenty of capacity worldwide from a manufacturing standpoint in the world, in the wood products industry. But the limiting factor is going to be wood, in terms of how fast that new capacity can keep growing. And so in some sense, there's not a crisis, but there is a need to grow more fiber right now.

To repeat a bit, I think you do need more time, if you want to reduce the number of mistakes. And I think the role research has to play is not only to increase productivity, kind of its traditional role, but also to increase your tool kit or your arsenal. If you're going to go into heavy, intensive management of plantations, which is what basically, Jari and most of the Brazilian model is, you really need to take an agricultural paradigm, where your research is always looking at your genetic base for your crops, whether it be between species or within a species, so you're not vulnerable to disease and other things. I think that's one of the key learnings, because the research can really help.

The other thing is to look at soils, that soils are your basis for growing these trees, and in growing different species. You need to make your species compatible with the soils you have, because it's very difficult and costly to change soils. Those are the key learnings, for me, forestry production-wise.

I think the other key learning, with respect to building an infrastructure, is one of the traps that really kind of sank the project from Mr. Ludwig's perspective. When he went into that project, he had the support of the government at the time, which was basically the generals running that country, or a cadre of generals. Over time as they went into the phase of *abertura*, or opening of the democratic process, I believe Jari was used, in kind of a populist type model of democracy, as a whipping boy for the local and national politicians. Here this foreign national is in there, you know, with our birthright. All the infrastructure was built by Mr. Ludwig, and the roads and everything else. He never could get what I consider the government to put in their fair share for supporting that infrastructure.

HKS: Interesting.

JCW: Now the new company, being a Brazilian company, I believe has gotten a little farther ahead in that respect. My feeling during this past visit is that even they are

having problems getting the government to support the infrastructure burden. They pay taxes, but much of the taxes they pay goes to the state government four hundred miles away. It's not being plowed back into the infrastructure there at Jari, so that that company continues to have to pay for a lot of that infrastructure. Any private enterprise that goes into a project like that really needs to make sure what the government is going to pay for and what they're going to pay for, because you're going into a pioneer area, and the government, being like most governments, wants to try to get the private economy to pay for as much as possible.

Computer Based Forest Inventory

HKS: Sure. Let's backtrack. We've already talked about how do you know things, and the library research, and consultants, and so forth. Let's go down the list from your outline. What was a computer based forest inventory?

JCW: We would measure the trees in the field. Using a pencil, we would write it on some forms that had already been preprinted from the past measurement of those plots, by tree, the diameter and the height and those sorts of traditional inventory measurements. Product class, whether it had a disease or not, whether it had died or not. We would write on these forms. Those forms would be sent to the United States during that period, be keypunched, using the old keypunch cards--

HKS: Sure.

JCW: --run on the mainframe computer, print out summary statistics of the plot level, by soil type. So we would know how the inventory was changing over time. But one of the main uses of that summary data at the plot level was to develop growth and yield predictions, because we had the same plot being remeasured over time. J. L. Albert in Oklahoma and myself, later Joao Borges, we were the ones basically that developed the growth and yield equations from those plots, plots using experimental data that we had on other places.

HKS: Each tree was numbered with a tag on it.

JCW: Yes. Each tree had a tag. There was a plot center, it was a circular plot, twentieth hectare in size.

HKS: There was a statistically valid model and all of that?

JCW: Yes. They were put in at random. One of the real advantages of using that information for our growth and yield was, as opposed to say experiments in the field, that those plots were treated just like the rest of the plantation. So you weren't getting something that had been treated in an extraordinary manner silviculturally. It was an operational based inventory.

HKS: So until you had that, everything was sheer guesswork.

JCW: Yes, but we started that inventory system back in 1972. Putting plots in all plantations that existed from 1969 onwards.

HKS: Yes. I'm not sure when Ludwig made the decision to have a pulp mill.

JCW: That's your point.

HKS: When he had to have a certain amount of stuff per day, when it became important--

JCW: By that time we had already had the inventory system in place. I want to say that the decision to build a pulp mill, was probably made about in 1977, '78, right around then. Because one of the reasons he floated that mill across was so he could get done quickly. They probably cut the project time by two years by doing what they did rather than trying to build it all on site. I would say about 1977, maybe '76, was when things started moving towards when that pulp mill would start.

HKS: I'm assuming that a pulp mill has to have a certain production capacity in order to be viable.

JCW: Sure.

HKS: So many tons per day or whatever it takes.

JCW: Yes.

HKS: You've got to start with that. It has to be at least that much.

JCW: Right.

HKS: Then you have to say, Well, can I get enough stuff off the land?

JCW: That's right.

HKS: I've read that there was still pulp imported into Jari, from southern Brazil, because there's not enough local production. That was in the '80s, '70s. I don't know if that's still the case.

JCW: Yes.

HKS: Was that a miscalculation? Or just good business practice?

JCW: No, it wasn't good business.

HKS: Was this a surprise when you didn't have enough to feed the mills?

JCW: How would you describe this? It was a combination of factors, one factor being the disease problem with gmelina. So that reduces yield. Then you start looking for something to fill in some gaps. So you look for eucalyptus. We chose *Eucalyptus deglupta*. Now *Eucalyptus deglupta* probably was not the best choice. It may have been the best choice given the information we had about the genotypes that were available to

us. Then you get the eucalyptus to fill in the gap. Another way you could have responded to that information about the yields on gmelina and then the *Eucalyptus deglupta*, would be to say, Well, we're going to plant extra acres to perhaps make up for that possible shortfall, though of course it's still uncertain even if you've got a shortfall. As a risk management type of thing, let's plant some extra acres. Then you're getting into the period where there's the transition to the new ownership, where Mr. Ludwig no longer owns the project essentially, or he knows he's not going to own the project. So then you say, does it make sense for us to plant risk management acres, when we're not even going to own the asset?

HKS: O.K.

JCW: And we probably don't need to plant in order to sell the asset, and particularly an asset that we're selling and we're not getting top dollar for, anyway. So I guess you could put those three things into play, the *Eucalyptus deglupta* not doing maybe as well as the current eucalyptus does, the gmelina giving you a problem, and then not planting enough acres to say when you're reaching into a kind of possible problem of a volume flow. Then you get this new company on board--and there's a bit of a speculation in here, obviously, what I'm saying, because I wasn't there after 1982 to know what goes on. But I have a feeling with the new company, they got into some cash flow things, they got into some of their own assumptions. I know, for example, there were some statements made, Well, we're really going to grow gmelina now because we're going to start adopting very intensive management, like in southern Brazil. We can talk about that later.

HKS: O.K.

JCW: That kind of a contrast. They got caught in their own paradigm, and cash flow problems. So as I understand it, the project continues to struggle with fiber flow in part because of cash flow problems, and not planting enough for risk management. We're getting outside my boundaries of when I was there, but they were buying fiber from AMCEL, which was not too far away, which was partly owned by one of the other companies that owned the CAEMI company. That's not a bad decision, because here you've got a pulp mill that can barge wood over to you. It's a win-win situation, the way I looked at it at the time, because the closest source for that pine fiber is that pulp mill. I mean, it's the closest mill around. I don't think it's necessarily a good situation to be bringing wood from southern Brazil or Bahia and so forth, because that's a pretty long stretch, without a lot of backhauls and all the other things you need in shipping. But that would be my scenario of how the fiber flow problem unfolded.

HKS: Did you forecast that there would be a shortfall?

JCW: No, we didn't forecast there would be a shortfall.

HKS: I'm trying to put myself in your shoes. You're out there working every day. You know they're building this pulp mill that in two years is going to come online.

JCW: Yes.

HKS: It's no longer theoretical. I mean, there's a certain pressure on somehow.

JCW: Right.

HKS: If that's the right word.

JCW: Right.

HKS: This is not an academic exercise in forecasting.

JCW: That's exactly right.

HKS: It must have been kind of interesting from where you were with this.

JCW: Since you're in a situation where you're pretty close to a hundred percent, you have to have a hundred percent self sufficiency, which is a totally different aspect of the problem than we encounter here in the States. Here most mills are 30 percent self-sufficient. Some companies don't have any self-sufficiency. We were using some of the native species we identified that we could use for pulping. When I was there we didn't do it, but we could get wood from AMCEL, you know, a barge trip away. So there were some outlets, but not like in southern Brazil, to some extent, or in the U.S. for certain. If you look at the yield projection aspect, I think it had to do with gmelina not performing, either because of the disease problem or because of the soil problem, to what we thought it could do. If you think of yield projection in the global sense, it has two aspects. There's how much, how well you can do projecting yields on a given acre of land of a given type. The other aspect is to know how many acres you have of that type. We didn't get into soil mapping. We used for our soil mapping a geologic delineation of the soils. Johan Zweede's area of interest and expertise was the geology of the land base at the project. We used geologic zones to identify our soils; we debated whether to go into an expensive soil mapping project, but we didn't start getting into that actually until after about 1982.

I guess the other aspect, in retrospect, is to think about how those plantations were developed and the technology. We were centered there in Monte Dourado, and you did have the ability to overfly an area. But aside from that, you had to go in with crews, camping out. Typically you would go out and you would do an inventory of the area, running lines in the native forest. Then you would make the decision, because the driving factor was how many acres to plant. So you'd go in there and you would clear the land that you had gone in by foot to get to. You'd build the roads after you had inventoried, and then you'd go in and clear it, you'd plant the trees, and you'd gradually just work yourself out from the town, being the epicenter. And as you did that, you tried to get some information about soils. But we didn't do any soil mapping at that point in time. In kind of a more perfect world, with more time, what one would have done, is one would have established experimental plots over the whole land base, you know, building roads way out.

But we didn't build our roads far. I guess there are roads out there now that are maybe a hundred and ten kilometers away from the city. But we would just build our roads gradually and put experiments in as we cleared plantations. In an ideal world the roads

would have already been there. You would have put the experimental plots out on the peripheries, or all over on all major soil types, and see how it responded, and done your soil mapping, figure out how many acres you had of all those soil types. And then you would have at least been a lot better on your yield projection. [laughs] But that's not the way it went.

HKS: Then you started there simply because it was a convenient place physically to build a town.

JCW: I can show you a map at some point here; I can show you where the soils are. I think in my article that I published I really talk a lot about this whole issue of the soils and which soils are better for growing gmelina and so forth. If you notice in that Puerto Rican article--the town is located on the worst soils for gmelina. Our best soils were over the mountain and up near the waterfalls on the project. That's probably a sixty kilometer haul, which by U.S. standards is nothing. We had to build all our own roads, you know, that's a pretty far reach up there.

HKS: I try to put myself in Ludwig's shoes. Various reports--he doesn't think a whole lot of academics, theorists, I mean. He's a practical man.

JCW: That's so. I agree.

HKS: He's going to make a big time decision based upon growth projections from three young, inexperienced people. He must have had a lot of confidence that you guys were doing something right.

JCW: He either had a lot of confidence or, I guess one could put another perspective on it, saying he was probably naive to begin with about forestry.

HKS: Maybe he didn't have any choices. What is he going to do?

JCW: That's right. Plus there were some people that had some experience. Take a Charles Briscoe, for example. He had had experience in Puerto Rico, he had experience in Mississippi. Now in terms of lack of experience at Jari. We all didn't have any. You know, we all were fairly inexperienced. We were inexperienced in that particular setting. He was willing to take a lot of gambles with a very limited amount of information.

HKS: How old was Briscoe at that time? I mean, was he considered a senior scientist? Would he have been?

JCW: I would say he would have been considered a senior scientist. I'd say he was in his fifties.

HKS: O.K. My perception was almost everyone except for the consultants were very young, in their twenties, early thirties. You, and Clayton, and Gilvary, and so forth.

JCW: Yes.

HKS: The senior people were the consultants that came in.

JCW: Yes.

HKS: The Zeb Whites, the Tommy Thompsons, and those guys.

JCW: I'd say twenties, thirties, and forties. I mean, there were some fortyish people in there, when I first got there. Again we're talking about a time stream in '72 through--

HKS: True. People aged.

JCW: Yes, it's hard to say.

HKS: I assumed that it was a hardship outpost, and people established in life were less attracted to it. You have kids in college here in the States, it's different than if you're starting out in life. You don't have a mortgage to pay in the States and all the rest of that, to take that job. That's sort of a selection process for those who actually went there.

JCW: In my experience in hiring people, not only in Jari, but in my current job, we talk a lot about motivational fit; how well a person would fit with that job, whether it be location or whether it be the job description. I would say that certainly someone young and single, you wouldn't have to worry as much about motivational fit as you would with somebody who's married with kids, because then you have to start asking yourself the question, Well, it's not only this person I'm hiring, I'm hiring their family.

HKS: That's right.

JCW: So you had to be a lot more careful in your motivational fit part of it, in looking at those people. I never was involved at that level of deciding, making decisions about some of the people who came to the project, but sometimes, I often wondered, at least in retrospect, how good a search process and how good a recruiting thing was done looking at motivational fit.

HKS: Recruiting would be kind of difficult.

JCW: It is.

HKS: The job market's back in the States and you're a long ways away.

JCW: That's right. It's an art in itself, even in the U.S. I see mistakes made all the time; people that are not doing a good enough job in the interviewing process.

HKS: I certainly make mistakes. Maybe a third of people I've hired over the years haven't worked out, and, to generalize, it's because somehow we never communicated what the job was. They were disappointed in some way. That might be too harsh a term, but it didn't work out for them. They never clicked in the job.

JCW: It didn't fit with what they want. You take a situation like Jari, and that's added in spades, because you've got that location issue. There's just a whole different element. It's a difficult problem.

Management Information System

HKS: Talk about the management information system.

JCW: I guess there were a couple of things there. Our plantations, early on we assigned each one of these areas that was cleared at a given point in time, what we called an absolute plantation number, which never changed over the life of the project. In fact, they're still using those absolute plantation numbers today. And so for example, let's start with this. You'd have each plantation being assigned a number, let's say number forty-seven. That was one up in the Pecanari area. O.K. Within that plantation you would have a fairly rectangular road system, depending upon topography. Each one of those would be assigned a number, a compartment number, one, two, three. O.K. We put that information in the computer, but because of our remote location, we also had files. When we did any kind of silvicultural activities, when we planted it, we would record--the area foresters would send in weekly to my group--what was done, where it was done, so we had a record. You can go over that rotation and say when it was planted, what the spacing was, when it was cleaned, how many times it was cleaned--meaning weed control--if it had been pruned or not. And so that was our management information system, to allow us to know silviculturally what was done.

At about half the rotation, we would do a stand level inventory, or compartment level inventory, to get basal area, height, which we would then use to project yields for that compartment. Those projections were what we were using to determine, when we did our harvest simulation, how much volume would be there to cut, to meet our target volumes. We basically were using area control. As an example, let's say you were on a six year rotation. You had sixty thousand hectares. When things got regulated, you would do ten thousand hectares a year, and that would lead to a certain amount of volume, and you'd get to the sustained yield. Now obviously, you never reached that theoretical state, but that's the way you sort of go about doing your volume forecast and harvest schedules. Today, that's now being put on a geographical information system (GIS) at Jari, because of what we can do now on microcomputers. The framework and the design of that system, even without the computers, was essentially the same thing you do today on a GIS system, where you have basically plantations divided up into compartments or stands, which you track over time with respect to yield and with respect to inputs.

In fact, I probably patterned it more off of what was being done in Australia and what you see in the British Commonwealth type literature with plantation forestry more than I did in the United States, because the United States really, until recently, and recently means the last twenty years, hadn't started tracking plantation yields like that. Now as we get into more intensive management, we're doing that, as we get GIS systems and so forth. But we had kind of a compartment registration system, as you would find in New Zealand or Australia. That's the way we did our management information system.

HKS: I was just thinking. When I went to forestry school, a plantation was an exotic concept, going to school in the Pacific Northwest. Probably something we might not even see in our lifetime. We were still old growth management.

JCW: Right. Right.

HKS: And here you were dealing with a six year rotation.

JCW: Right.

Tactical and Strategic Forest Management

HKS: Let's go on to the next topic. Tactical and strategic forest management. Harvesting plans. How do you coordinate this? Does Gilvary ask to buy the chainsaws and stuff, logging equipment, to keep up with the harvest?

JCW: No. No, Bob Gilvary--he was responsible for engineering, not forest engineering.

HKS: O.K.

JCW: He was the guy responsible for building the roads, building the town, building the water treatment plant, building the pulp mill, or helping with building, that sort of thing, civil engineering. Building the houses, the school, the hospital, all that sort of stuff. Going back to the way things evolved, we started with just forest management, growing trees. Then you got into the facilities planning type issues. At some point, Clayton Posey moved back to the States, and they formed a forest products group for Mr. Ludwig out of Stamford, Connecticut. That's where all of the planning and the decisions about what kind of pulp mill to build and all that sort of thing was done. At the same time, down at the project, we were gearing up, saying, What kind of harvesting system do we want? And hiring people to look at that issue, to get ready, because here from scratch, in the middle of nowhere, we were going to have to set up a harvesting system for the planted forest. Up until this time, we had done a little bit of native harvesting, but not much. There was a small sawmill on the project before the pulp mill started, for local consumption. The first job, from my perspective, was looking, before we even got there, was to sort of do these volume flow projections, as we talked about, and some of the pitfalls and difficulties of that, and coordinate that. That would be strategic harvest scheduling, coordinate that with what the people in Stamford were asking, and saying, here's what we think the yields could be, but you're going to have to cut trees at a young age. Those sort of issues. Then as you come closer to actually cutting the trees, when we got online with the mill running, what I would call tactical planning is to make your one year harvest plan. In other words, what the question then becomes is, What stands am I going to harvest in 1981?

I worked with the people in procurement to give them some information on what the age of the stands were, and from stand level inventory what volume to expect off of each one of them, what the tree size was on them, because that determines harvesting cost, and help coordinate with the management part and the procurement part to know

how much would be cut and how much needed to be planted after the cutting. The people in Harvesting, a fellow named Mac Davis, who used to work for IP, was the harvesting manager, and his main staff support was a fellow named John Sessions, who's out at Oregon State now. When Mac left, John became in charge of Harvesting. On the Forest Management side--I think by that time Charles Briscoe had left, and I think Robin Collins, who'd worked for Westvaco in southern Brazil, was on the Forest Management side. Then you had Johan Zweede in Forest Operations, who was the boss of both those. Then my job in the tactical, strategic, and operations planning was as a staff support for Johan and for Mac Davis and for Robin Collins, to kind of help them coordinate their plans.

HKS: So Mac Davis would determine if he had enough workers, enough axes and saws, to actually harvest the amount of materials.

JCW: Yes, his job was to set up the harvesting system and the contractors.

HKS: I suppose Gilvary would make sure the roads were in place.

JCW: By this time the road system was pretty much in place, because we had to have the road system to plant the plantations. A major project that Bob worked on was the railroad, because that was an addition that was put in to handle the volume of wood coming into that mill. Ludwig at the time did not have plantations on the other side of the river, because that was the federal territory and he didn't want to develop over there. That changed subsequently. So the mill was located on a peninsula, and so all the wood had to come from the west. And so there was this sort of narrow funnel this had to come in, and one of the reasons behind the railroad was to try to not have so many trucks coming down the road. It was to help out logistical nightmare.

HKS: An anecdote he gave--early in the game, I guess when engineers were still running the show, he said they were clearing so many acres per year that the guy in charge of the nursery didn't produce enough seedlings to plant those acres. Lack of coordination. Obvious things, apparently obvious things now.

JCW: That's right. That was before my time. I'm speculating, but here you're talking about learning how to grow seedlings in a nursery, too.

HKS: Sure.

JCW: So it might have been that the nursery thought they were growing enough seedlings for "x" number of hectares, but then they had a failure, so they wound up with not enough seedlings. Who knows? But some of it could have been coordination, some of it could have been a downfall in nursery production.

HKS: Sure.

JCW: But by the time I was there, that problem was pretty much ironed out. I can't think of any time where we lacked seedlings to grow.

HKS: Was labor turnover a problem?

JCW: The labor in the early years for planting was from contractors, or from contract labor from part of northeast Brazil, where they really have a labor surplus and where people welcomed the work. They were looking for work. They would come up for a year at a time, or six months at a time, to work. That system inherently has a lot of turnover. But that's labor intensive, you know, planting crews. Now in terms of turnover, I'd say that where it was more of a problem, probably, was the turnover at the higher echelons, like the directors of the project changing.

HKS: Every six months or something.

JCW: Things like that. That was probably a bigger labor turnover problem, in terms of direction, than at the other end.

HKS: Do you want to comment on that, because I think there were thirty-four or thirty-three directors before Clayton. Some large number like that.

JCW: I don't know how many there were.

HKS: How did that affect you where you worked? I mean, the boss was maybe two or three levels above you.

JCW: It pretty much didn't affect me. I thought it was all just kind of interesting. But I think where it affected the project.... First of all, one has to ask the question, Why would that be?

HKS: Sure.

JCW: I can think of three different reasons that it would happen. One case, and it gets back to this recruiting issue to some extent, a very large extent. This would be a person Mr. Ludwig would hire, obviously at this level. Mr. Ludwig's vision would be different than what the person's vision was, and there would be a clash of personalities, hence we know who wins that one. That would be one possible reason. Another one would be a lack of motivational compatibility. I think there were a couple directors that, they had some personal problems, that they were let go for that reason.

HKS: Clayton lived there. Did they live there, or did they live in Belém or someplace else and fly in once a week, or was that an issue?

JCW: For my time there, they all lived on the project.

HKS: O.K.

JCW: I think another problem is communications. Even though these people might have been able to work out a good relationship with Mr. Ludwig, there was the physical isolation. We didn't have phones there for most of the time I was there. Just to give you an anecdote, when I went to Belém in 1971 in order to make a phone call--this is a city of five hundred thousand people--you had to go to an office of Telepara, the Brazilian phone company, and stand in line for an hour or so to make an

international call. This is for the whole city, O.K.? Now, we didn't have any phones at the project. We had radio contact. That happened for a number of years.

HKS: Who did you call on the radio? Somebody in Belém?

JCW: They could call the airport in Belém, or they could call the office in Belém and talk that way.

HKS: Oh, I see.

JCW: So other than that, there wasn't any contact. It was a very isolated situation. We didn't have a private corporate jet or anything like that. We did have the DC-3, but again, that's once a week. So it was a very isolated situation. Then over time, at some point Telepara established a telephone link there in Monte Dourado where you could go and wait in line for an hour to use the telephone.

HKS: O.K., that's good.

JCW: Now, they've got telephones in everybody's houses. You can call them, make an international call from the guest house there to the States or anyplace else. So I guess what I'm trying to say about directors, given that kind of a communication situation, if you're Mr. Ludwig, how are you going to talk to your director? If you're a director, how are you going to talk to Mr. Ludwig? How are you going to discuss these things on a day to day basis, probably very important strategic decisions? If you got Mr. Ludwig, who's a very micromanagement kind of guy, and you don't establish a good relationship of trust, and you don't have time to, because you've got such turnover, I think that can create tremendous problems.

HKS: Sure.

JCW: So anyway, that's my take on director turnover.

HKS: The articles I read--I didn't read many newspaper articles, but in magazines, it was Ludwig's eccentric style that caused the turnover. Of course everything was blamed on him, and as head man, maybe that's fair.

JCW: I think the press is like all of us are sometimes. Simplicity is a lot easier to deal with than reality. We just want to look for one root cause for everything, and I think that we know that life's a little more complex than that. One can certainly blame Ludwig's eccentric style. That might have been a necessary condition for the firing, but it might not have been sufficient.

HKS: I asked Clayton how he survived for all those years. He said, because he wasn't afraid of being fired. He said, if you stopped worrying about that, and you just had to do-- even if you disobeyed an order--you had to do what you thought was right. But if you got to second guessing yourself, you would wind up losing the job. That was his answer why he lasted longer than all the thirty-four predecessors put together, apparently.

JCW: I don't know.

HKS: Of course, communications was better by the time Clayton got in charge, too.

JCW: It was a little better, but still that was--I don't think when Clayton was in charge, we might have had some telephone, one telephone in Monte Dourado. We didn't have much more than that. It was still pretty weak. Who knows what it is between individuals, the rapport that's established? It's hard to say.

HKS: I haven't kept score, but maybe only twice, in all the times you've mentioned Ludwig, you said Mr. Ludwig, and the deferential statements by Clayton, and by Bob, and yourself toward that guy--it's intriguing. You always call him Mr.; he was a special person in your mind somehow.

JCW: Yes.

HKS: And yet, it wasn't called Ludwigandia, like Fordlandia. He didn't have that kind of vanity, did he?

JCW: No, he didn't.

HKS: He didn't put his name on it.

JCW: No, he didn't. He was a very focused individual, for all the good and the bad that is, being focused. It depends on what you're focused on, I guess. But vanity was not one of his focuses. In fact, if we think about how the Jari project or Mr. Ludwig managed the press over the years, that might have been one of his weaknesses. Maybe it would have helped if he had had a little more vanity, so that he would have been a little more worried about how he projected his image. I know a reaction I would get if I were in a conference or something and said, I work for the Jari project, or from a journalist, let's say, Oh, that's very secretive. You people don't share anything, you know. You don't want to let anybody know what's going on in there. Speaking from the people I was around, I don't think that was the purpose. I just don't think Mr. Ludwig felt like it was anybody's business what he did there. It was his money, it was his dime, he was stepping up to the counter, he could spend his dime the way he wanted to, and it wasn't anybody's business. It wasn't that he was really trying to hide anything, as much as he said, Well, what's it to you, you know? This is not your project. I own it. I can do what I want to.

HKS: Sure.

JCW: Now, we realize in the world we live in today, that's a fairly naive view; I think maybe back then it wasn't quite as naive as it seems today. Particularly with respect to the political changes that took place in Brazil. With that *abertura*, and some of what I call just plain demagoguery that happens in a populous type democracy. When populism became an important factor, I think that hurt and caught the Jari project blindsided. So maybe Mr. Ludwig should have been a little more vain.

Planting Stock vs. Container Grown

HKS: Could be. I read through your articles, and I jotted some things down that struck me as significant. You may not agree, that it all didn't start with those. And some of this, remembering what Clayton said, how he dealt with some of the issues. Pine planting stock versus container grown. The container grown, Clayton talks about how he went up to Jacksonville, Florida, to St. Regis, and designed the little carton to grow seedlings.

JCW: The little pots.

HKS: He went through that whole thing; it was important to him. I mean, he told the story.

JCW: Sure.

HKS: You weren't as influenced by that as I was. Tell me, for the record here, planting stock versus container grown.

JCW: You mean bare rooted?

HKS: Bare rooted, yes.

JCW: Bare rooted versus container? I never got involved with that issue, so I guess that's why it wasn't important to me.

HKS: You mentioned it here in your paper. You call it pine planting stock. I can't remember now exactly what you were referring to.

JCW: O.K., I guess I need to look at that paper. The reason we used container versus why we didn't use bare root.

HKS: O.K.

JCW: We felt like we were getting better survival with the container stuff. We felt we needed that for the pine, given our long dry season, and so we never really looked at bare rooted like they did in southern Brazil and we do here in the U.S. Since labor costs were a lot cheaper, it wasn't a big problem. We don't go to container in the U.S. for two reasons. One is it costs more to produce container stuff, until maybe now with the smaller containers you can do better. The other reason is it's more costly to plant. But we had fairly cheap labor, so labor cost was not as much of an issue, and we felt survival was a lot more important. They're not planting pine today in Jari. They're planting a little bit. And I can't recall if they're bare root planting or if they're using small plastic bullets or not.

How Much to Grow

HKS: I copied this quote down, and I think you already answered it, but let me go through it again.

JCW: O.K.

HKS: "A common directive to managers"--who you don't define in the article.... You're not a manager in this job. You're staff, right.

JCW: Right.

HKS: O.K. The managers were--any Brazilians?

JCW: Well, Brazilians and Americans.

HKS: O.K. "A common directive to managers during this period was the need to develop this resource potential at a fast pace." That's Ludwig's tactic.

JCW: Yes.

HKS: "The desired rate was often made explicit by the setting of planting or future volume targets." That doesn't strike me as profound now as it did when I copied it, but then I've been listening to you for several hours now. You have to have a target. And the mill itself was a target, its capacity, I suppose.

JCW: I think the first targets, when the mill was still just a dream out there, was to say, Well, we're going to plant "x" number of acres. I don't know how that was derived. I think one year we planted sixteen thousand hectares. That might have been our maximum we ever planted. That's a tremendous amount to plant for an organization in one place. That was intended to be the first driver. Then the next driver said, Well, we want to start a mill, in such and such time. Now what do we have to plant to get that volume?

HKS: Would it have been irrational to have had excess production, excess to what the mill could accept? Is there an export market for that? Or would the mill be actually the limiting factor both ways?

JCW: I see what you're saying. I think Clayton sort of started this paradigm, and several of us continued it. I don't know that I would hold as strongly to it now as we did then. The paradigm was that, unlike some of the temperate species, where you could plant the trees and you could hold the volume on a stump, with gmelina, you couldn't hold it on the stump, because it would stagnate or it would die or something. Therefore you didn't want to plant more than you needed, and you needed to have fairly fine tuning on that. If I were to redo this thing, I wouldn't accept that paradigm. I think you can hold it longer. Now you can't hold it for ten years, but I think you've got a little more window to plant excess.

HKS: Was there a plan for a second pulp mill and all that? I mean, if everything had gone well and the hydroelectric plant and the--none of this happened, but...

JCW: I never knew what was on the drawing board completely. There might have been that. One of things was the hydroelectric, of course. The original idea, from what I

could gather, was not the pulp mill. It was more solid wood products. I think I mentioned this in my Puerto Rican paper--the first idea was to plant gmelina, grow it on about a ten or twelve year rotation for a white wood veneer, and use thinnings perhaps for pulp and have a pulp mill. Some of the major things was to produce a white wood veneer. That's why Weyerhaeuser was down there.

HKS: I see.

JCW: We had a regime at one time for pine--I want to say thinning it at six or seven years of age, thinning it again at twelve, and maybe clearcutting it at seventeen years of age. This is a real early model, back in 1973 when we had the first plan. Originally it was solid wood products with pulp as an aside, and paper. As time went on, the pulp and paper became the driver. Now why did that happen? Partly because we saw that gmelina, without some further genetic refinements, particularly on poorer soils, was not a very straight tree. Gmelina has the characteristic, the poorer the soil, the more the tree looks like an apple tree.

HKS: I've seen some photographs of trucks with this twisted stuff on them. That was gmelina logs, probably.

JCW: Yes. On a very good site the thing grows straight, tall. That's probably where the paradigm and the stagnation came in, because I do believe it's true that if you were trying to grow gmelina for solid wood products on a good site, you need to come in there and thin it and keep that growth up, because it will--I don't know if stagnate's the right word--it will lose its ability to respond. It's a fairly short-lived tree, like cottonwood, you might say, but shorter-lived than cottonwood, and so you lose that responsiveness to keep it on its growth trajectory of big diameters. Of course there's where *ceratocystis*, the fungus disease, comes in because that's where we started the pruning, to make clear wood for the veneer option. And you go in there and thin it, and you leave more places for the *ceratocystis* to come in. It tumbled together to where the solid wood product option actually hurt us in terms of *ceratocystis*.

HKS: There were sawmills on site, right? A hardwood and a softwood sawmill?

JCW: No softwood sawmill. There was a hardwood sawmill. Let's talk about two things. Prior to the pulp mill being built, there was a hardwood sawmill, a local one, just for our own consumption. Then we tried some export also, or export out of the project. I don't know where it was sold to. Then when the pulp mill was built, there was a sawmill built in conjunction with the pulp mill for sawing native logs. Actually it had two reasons. One was to saw native logs for producing lumber for possible export, but the other was for a chip production. Part of it was to produce chips for fuelwood. So native wood, once the mill was on stream, went in three different directions. Those species that had been identified as pulp species were used for pulping. Those species which didn't have any lumber value went directly to fuel. And those species that had some lumber value were sawed for lumber with the other part of it going to hog fuel, for fuel for the boilers in the pulp mill.

HKS: O.K. Clayton talked about this large sawmill, large in terms of to saw large logs.

JCW: That's what I was talking about.

HKS: It was a battle that he lost, that there is still enough stateside thinking driving the decisions down there that he wound up having to accept this large saw sawmill.

JCW: The mill was designed, I think, by Simons out on the West Coast. I think what Clayton's referring to was that that mill was really designed more like a west coast sawmill, a softwood sawmill. As most people in the industry know, softwood and hardwood sawmills are totally different animals. A softwood sawmill tends to be a mill that's going for a maximum throughput--

HKS: O.K.

JCW: A hardwood sawmill, it's going for quality, being very careful about how it saws up. I think the battle Clayton is probably referring to is the battle that that thing was designed more for producing chips for the fuel and stuff. It wasn't being run like it was a hardwood sawmill. It was tied to that pulp mill.

At one time, even after that was built, we put some thought into maybe even building another smaller sawmill, or doing something with it to try to capture some of the lumber value. But that's a whole different issue, the whole thing of how to merchandise those trees and find markets for those trees. Those are upland species, and the worldwide markets are accustomed to species along the river in South America, that float, with lower specific gravities. We spent a lot of time trying to market--we had a wood tech lab, did a lot of testing and so forth, and with mixed success trying to market it.

HKS: Let me pick up a point on gmelina and the pruning that made it susceptible to the chancre disease. The pruning was done to create clear wood.

JCW: That's right.

HKS: For a non pulp market.

JCW: That's right.

HKS: So was it with the idea, at that time, that the thinnings would produce enough pulp?

JCW: If you go back to when that was the paradigm, O.K., of producing lumber and so forth, then, yes, it would. The question at that time in the planning, and one of the things they looked at was, Well, let's see when this pulp mill needs to come on so that we can regulate the thinnings. A lot of wood to generate from thinnings. This is one of these things that was discussed, I think, up in Stamford, Connecticut, as they talked about different things. There was probably a communication problem in that a lot of this facility's planning was being done up there, and yet the data for doing the yield projections--not only the quantitative data but the field operational planning was down at the project, many thousands of miles and not a phone call away. We know there are problems that exist like that even in the States, where people are located just two

offices down. So this thing about the solid wood and the thinnings generating the pulp--I don't know how far that got. But I believe it was abandoned fairly quickly, within a year or so. It became more clear that we would have to generate that volume if we wanted a pulp mill to go with more clearcuts. That's a question to ask Clayton, how that whole evolution of different facilities planning took place. I don't know the answer to that, really.

HKS: I'm pursuing this gmelina business and the pulpwood mentality, when that set in as opposed to having saw logs or veneer blocks, or whatever, and the shifts that would make in terms of management decisions.

JCW: I don't know when it set in chronologically. I know what kind of caused it is we looked at the yield projections. I want to say it set in in about 1976 when some of this planning was starting to be done, looking at sawed wood. By that time we had some yield projections that were indicating--we had plantations by that time that were planted in 1969, that we had the plots measured over time on some fairly good soils. What we were seeing was that the mean annual increment, the volume productivity, was peaking earlier. When we had thinned some plantations, and they were not responding to the thinning, which was saying that if you wanted to go with a sawed wood cycle, you were going to have to take a hit in terms of total productivity. You were going to have to either have big trees or you could have more volume per acre per year. It was becoming apparent that that was a problem.

We had an experiment, in fact it was the initial experiment that Clayton put in for pine in 1970, where we had thinned that at about age six or seven and the mean annual increment curve, after we thinned it, the trees did not respond to the thinning. My working hypothesis is the reason that didn't take place with the pine is that we had so much genetic variation in that initial seed source that we had, that we didn't have the best genetic stock, so the trees couldn't respond to the thinning. Now you could also add on a hypothesis perhaps, and I can't test this, but, that maybe with some proper fertilization.... We had fertilizer experiments. Now we didn't have them, I don't think, in mid rotation time, but maybe with proper fertilization you could get them to respond more to the thinning. But I primarily attribute the problem of not responding to thinning as genetic in origin. I think that with the right genotype you probably could get a better response.

That sort of laid the ground for some of the difficulties for a solid wood products regime, because if you're going to take a hit on your mean annual increment by thinning, you have a fork in the road. You're going to have to have lower productivity or you can say, Well, look, I'd rather have higher productivity to generate more fiber and go for a pulp mill or something.

HKS: Given that chancre was a problem with gmelina, and the chancre was a problem at least in part because of the pruning, when you went to a pulpwood paradigm, you would stop pruning.

JCW: That's right.

HKS: Didn't that help alleviate the chancre problem?

JCW: That was our hope, that it would reduce the chancre problem. I think it probably did. If we had kept pruning, we would have had even more chancre. But you still had chancre out there, and on top of that, you've got the problem of when you coppice the trees, you're just creating a place for the chancre to survive and to get in there. I think the chancre problems with gmelina probably could be solved over time with genetic testing. But again, do you want to spend your resources doing that, or would you rather go to something like eucalyptus? This is again where research comes into play, and we put out some eucalyptus trials. The company, after Mr. Ludwig's time, put out additional eucalyptus trials, and I think the conclusions they've reached today is to say the better strategy is to go with *Eucalyptus urophylla*, or something else, and don't pursue the gmelina strategy, which to me seems rational at this point.

HKS: There are several hundred species of eucalyptus, right?

JCW: Yes.

HKS: How many are commercially viable?

JCW: I don't know.

HKS: About a dozen? I mean, a small number.

JCW: I'd say a fairly small number.

HKS: But enough is known about eucalyptus that you could make logical choices of what to experiment with.

JCW: The other advantage, from an industrial standpoint, with eucalyptus is that you're not the only one working on it. In other words, you've got a wide variety of experience, albeit not in the same location and on the equator, but you've got a lot of facilities working with eucalyptus.

Aracruz got some of their first start from eucalyptus in the Congo, which is closer to the equator--Zaire. And so there was some experience there. Now I don't know enough about that experience in Zaire with eucalyptus. I just know that from some of the history I've read is that that's sort of where Aracruz got some of their first start, was with some of the eucalyptus in Zaire.

Leaf Cutter Ant

HKS: The leaf cutter ant comes up a lot in the literature, and you mentioned it, and the use of Mirex or whatever.

JCW: Yes, Mirex.

HKS: It was a real problem? A serious problem?

JCW: It's the kind of problem that's an endemic problem. It's endemic in the same sense that southern pine beetle is endemic to the southeastern United States. The difference is the way you go about controlling it. With leaf cutter ants you find ways to kill the pest. But you're never going to eliminate it. Almost like fire control, you just put that in the budget as an annual cost. You're never going to eliminate fire, but you're going to put in methods to reduce the incidence of it. It's the same thing with leaf cutter ants. Leaf cutter ants are a problem not just to Jari. They're a problem all over Brazil, in one form or another. They just learn to live with it.

HKS: I was touring in Costa Rica at the OTS operation at La Selva. For us gringos, the leaf cutter ant, this was something wonderful. We'd stop, we were in awe of these--

JCW: They really are neat.

HKS: They're marvelous things. I didn't realize they were a problem until I started reading about the Jari experience. Do they kill the tree? Or just defoliate?

JCW: They can kill young trees, I guess they can even kill older trees if you let them defoliate that same tree repeatedly. But generally the biggest problem is that they reduce the growth quite a bit, because you don't have any photosynthesis taking place without leaves.

HKS: The leaf cutter ant is an issue, in a plantation situation, it wouldn't be under so-called normal, uneven age stands, because you have this concentration of small trees.

JCW: I'm not sure I understand. Leaf cutter ants attack big and small trees. In other words, in the native forests, they go up big trees and cut them. It's just that it's not a problem because you're not trying to maximize wood production. The native forest there is probably not producing in terms of merchantable volume more than three cubic meters per hectare per year. Whereas in Brazil with eucalyptus you're trying to grow thirty cubic meters. So you're trying to grow ten times as much fiber per hectare per year than you are in the native forest. If all you're trying to do is produce three cubic meters, or four cubic meters, leaf cutter ants aren't a problem because you're just taking that into account. But if you're trying to maintain these high yields and these insects are coming in there cutting down your photosynthetic factory, then they become a real problem.

HKS: Genetic selection would work for diseases, but not for insects.

JCW: I'd hate to say never, but it would be very difficult, it seems to me.

HKS: I guess it would taste bad or something. I'm not sure why insects wouldn't do that.

JCW: The thing that's always interesting to me about diseases and insects, and we struggled with this in the Southeast with *Cronartium fusiforme* on loblolly pine. We talk about getting genetic resistance. But sometimes when we say it, we forget that we've got two organisms here, we don't have one. And both those organisms are capable of adapting. They're playing a game here, because once you move the genetic

genotype on your primary species being attacked, you cause some changes in the genotypes of the pathogen.

HKS: Sure.

JCW: That's why I say when you think research in the tropics, just like in agricultural crops, you basically are entering a game of one genotype against another genotype, the pathogen against the host. We are trying to manipulate with our selection and adding to our arsenal ways to counteract that. We've had a lot of success in domestic agriculture with that strategy, and I assume we're going to have a lot of success with that in industrial forestry.

HKS: Was the leaf cutter ant a problem with pines, or only the broadleaf.

JCW: Both.

HKS: What diseases bothered the pine?

JCW: We didn't really have any diseases bothering pines. I think there was a needle cast disease we would have, but it was the kind of thing that, like most needle cast diseases, we would just see some brown foliage, but it would go away. You couldn't come up with any economical way that it would significantly increase your volume production by getting rid of it. So it wasn't really a problem. So I would have to say in our situation, there were no significant diseases with pine.

HKS: The insecticide you used, Mirex. That was the most effective? Did you experiment on--

JCW: We used three different approaches. One was the Mirex, which was the bait. It's the same thing that we use for fire ants here in the U.S., or very similar.

HKS: O.K.

JCW: The bait approach. With that approach you would broadcast it. We put it in plastic sacks to keep it dry, because if it rained the humidity would ruin the Mirex, ruin the chemical. That was one approach. The other approach was using methyl bromide at the time, and you would stick a hose down into the ant hole and you'd basically fumigate the ant hole. The other approach was another fumigation method that is still used in Brazil. There's a chemical in the sprayer which hits a hot shield, which atomizes the chemical. Then you spray that down into the hole to fumigate the hole. So that's the third method. We used all three. We had a forest entomologist on staff, worked for Ron Woessner, and most of his time was spent with the leaf cutter ants problem and improving methods of treatment.

HKS: One would think there'd be an extensive literature on that, because if it's so widespread, everyone has this same problem.

JCW: I have a book, in fact, called *As Souvas* which is the name for leaf cutter ants in Portuguese. There is an extensive literature in Brazil on the leaf cutter ant. But it's a

little bit like there's an extensive literature on psoriasis and asthma. There's no single, complete solution to it.

Worker Safety

HKS: I don't want to sound like a journalist if I ask this question.

JCW: That's O.K., go ahead.

HKS: Worker safety. People are handling toxic materials. You're putting toxins into the environment, in terms of our standards here in the States, EPA's requirements and federal statutes, state laws and so forth. How much of an issue is that when you work in Brazil? Are you accused of not having the workers properly clothed?

JCW: We operated according to the standards of Brazilian labor laws. We worked within the culture that we found ourselves.

HKS: I understand you can't use DDT in the States, but it's used in other parts of the world.

JCW: It might be. We didn't use DDT.

HKS: That's an example. It's something that's illegal here but it's not illegal someplace else.

JCW: I know. Different cultures have different standards.

HKS: Since Jari was seen, at least in the later years, as imperialism or as not a good thing for Brazil, because it wasn't Brazilian, were these sorts of things ever an issue, that double standards? Your answer is no.

JCW: We tried to be consistent with the labor standards. There were Brazilian authorities that would check up on us. We followed all the same labor laws, everything else.

HKS: I can remember when I was a forestry student at the University of Washington, taking silviculture, we went out on a field trip. This is in the late '50s. We used 2-4D and 245-T without any protection, any warnings.

JCW: Yes.

HKS: We didn't wash our hands afterwards--

JCW: No.

HKS: Nothing. Zip. You don't do that anymore.

JCW: No, you don't. I've had the same experience, of using 2-4D and 245-T without the same level of safety precautions that we use today. It's not for me to judge. I'm not

talking about Jari or anything, but it's not for me to judge what is the appropriate level of rigor, because I think it has somewhat to do with people's tolerance for risk and uncertainty. Some people, we know, are very risk averse.

HKS: Sure.

JCW: They'll avoid any situation at all. That's why they use organic things. But coming back to Jari, we basically followed the legal standards of the society.

HKS: They were well-articulated standards? They weren't vague, in terms of whether you had to wear protective clothing or not?

JCW: Yes.

HKS: It was spelled out.

JCW: In general you'd say that there weren't many standards.

HKS: Hard hats weren't required, like OSHA requirements.

JCW: No.

HKS: Nothing like that.

JCW: A lot of us didn't use them. We had some accidents, but relatively few accidents for the number of people we had working--and I can't back this up, because I don't have any statistics, but it would be interesting. My perception is, incident rate per number of workers was probably not a lot higher than it would be in the States, because we had such a sheer number of workers. But where our biggest safety hazards were, to me, is in vehicles. We had dirt roads, dusty in the dry season, which would go from roughly August through December. You had these dusty roads, and I used to think that a lot of Brazilians felt like they were Emerson Fittipaldi, the race car driver. Of course Rio has a big reputation for bad driving. I think exceeding the speed for the conditions was our biggest risk. In fact, one of the workers I talked about that used to work for me, Cristovam (it was after he stopped working for me and while he worked for a logging contractor), was killed. He was killed in a head-on crash with a pulpwood truck. I warned Cristovam several times about his speed when he was driving a pickup, because people had seen him speeding, and I'm sure it was excessive speed. The contract laborers would be in the back of a truck, which of course you couldn't do in the States. You'd have to have a bus. I guess we should have had buses, or Brazilian society should require buses. If one of those things turned over, people are going to die, or somebody's going to get hurt seriously. I know it happened one time.

HKS: Clayton, as I recall, mentioned the difficulties in keeping certain employees who were technically acceptable. They philosophically didn't want to work in a place that seemed to be exploiting local labor, who didn't provide adequate medical care for the Brazilians. This is Americans working, basically.

JCW: Yes.

HKS: He didn't expand on this. It was almost an aside. I didn't know if that was a major issue, or he just remembered a couple of guys who really thought, Ludwig has billions. Why aren't we building more hospitals?

JCW: I never discussed that with any of my peers. My training at Yale was a master's degree in forestry and economics, and the courses I took at Yale in economics were primarily in economic development. I took a macro and a micro course, but also took mainly some courses in economic development. At that time one of the models was the model for economic development in a labor-surplus economy. Basically my attitude was to look for the appropriate technology for the cost of labor and the availability of the labor in the society. The appropriate technology is not necessarily the most capital intensive technology available. From a western European perspective, you could come in there and you could say, Well, look at Jari. They're exploiting these laborers. These people should have air conditioned trucks, or they should have air conditioned cabs to their vehicles, O.K.? My perspective was, Well, if we do that, then we basically are going to get rid of laborers, because capital is going to be substituting for laborers. Where are these people going to work? Is it better for these people not to have a job, to go back to northeastern Brazil and maybe starve or work at subsistence wage and die of some parasite? Or if it's their free choice, because these people were not slave labor, if it's their free choice to come and work under these conditions, save some money, go back--later some of them brought their families and became permanent workers--who am I to judge? I subscribe to appropriate technology, labor-surplus economy type model.

We were talking about plantation management, giving a contrast to Jari in the early years versus what was done in southern Brazil by some other firms. One of the interesting things to me was we adapted what I considered an appropriate technology for silviculture and harvesting, which was not as capital intensive. That is, we didn't go for feller bunchers and all the rest of the stuff. As you've read and seen, we used a big stick harvester, which was a thing used in the South up until the early '60s, and which is a fairly labor intensive method of harvesting. Now it's not the most safe thing to do, or certainly we can find a safer way of harvesting, but it gave people jobs. It was the lowest cost method of harvesting, given our labor rates and the economy as a whole and a perfectly competitive society.

As an economist, I believe that in general the best estimate of the true cost of resources to a society is the prices observed in a free market. Now granted, we can think of externalities and so forth, which create exceptions to that, but in general our best estimate is the market price of things. If the labor cost is thus and so, and the capital cost is thus and so, we ought to use the appropriate technology based on those costs.

For various reasons the firms in southern Brazil decided to go to a more capital intensive approach. They have feller bunchers and all sorts of stuff. We can talk about some of the reasons that might be. But one reason may be because that was what they were familiar with. They had more exposure to labor problems. In other words, it was kind of a hidden cost of labor.

In later years at Jari, that is what Jari has moved more towards, more capital intensive because, as we talked earlier, the costs of the infrastructure. If Jari's going to have to

furnish the schools and other infrastructure (as opposed to the government), then there's this hidden cost of labor, which is saying, Well, you need to get more intensive in your harvesting systems. And that's what Jari is doing, for better or worse. Now one can argue from a Brazilian perspective as a whole, maybe the government ought to provide the infrastructure so the labor costs wouldn't be so high, and so you could have more people employed gainfully and make a living wage.

HKS: In the States, I've been told, one of the things that wiped out the naval stores industry was a shift in the federal laws, that workmen's comp is now required. It increased the cost of labor.

JCW: That's right.

HKS: They stopped producing it by that method. Then all those jobs were lost.

JCW: Yes.

HKS: I don't know if it's a philosophical question or not. Whenever the debate in Congress is about raising the minimum wage the same kinds of issues come up. You make the jobs more expensive, and McDonald's will start automating certain things.

JCW: Right. I don't know if it's philosophical. It's just a fact of life that if you're a producer, an entrepreneur or whatever, and the cost of any resource goes up, then you're going to look for substitutes for that resource. That's the issue. Look at safety. If Jari was to say, Well, the safety standards of Brazil are not good enough for us. What is the reaction? We are going to give everybody steel-toed boots, we're going to do all this stuff, we're going to use buses, but you have to say that increases the cost of labor as an input. Which then means you need to go to a more capital intensive system. I think it becomes a philosophical and income distribution issue to say: Is it better to do that and hire fewer laborers, or is it better to accept the standards of society and hire more laborers? I don't know the answer. That is a philosophical issue.

HKS: Yes, it is. Let's move on. Here is the company newspaper, '78. Let's talk about it. It's in Portuguese.

JCW: I don't know the dates. There was a company newspaper called the *Jarilino*. Newspaper may not be right--newsletter would be appropriate, I guess. This one's July '78. Earlier we were talking about safety equipment and that sort of thing.

HKS: Right.

JCW: It's in Portuguese, but it says, Acceptance of safety equipment by personnel. This is an article that's talking about the issue of how do you get workers to accept the use of safety equipment? I know after the mill got started, there was somebody responsible for safety. And before there was also somebody responsible for safety issues. This sort of article kind of gives you a feeling for where we were at. There weren't Brazilian laws that said you had to use this safety equipment in rural settings. But we were trying to get people to just start thinking about the use of safety

equipment, why you should use safety equipment. That's what this article in the newsletter was about.

HKS: Yeah. I remember I worked for the Forest Service in the late '50s, and we fought on the ground level all the safety equipment. If we were alongside water, we were supposed to wear life jackets--you couldn't get your job done.

JCW: Well, one of the unique things in our situation at Jari was the weather, being so hot. Much of the safety equipment that I've seen for woods workers is designed for the northern hemisphere, Europe, for example, where you have fairly a temperate climate, cool weather. If you wear that safety equipment on the equator, you'll wind up with dehydration, for woods workers, at least. For example, chainsaw protective coverall leggings and all this sort of thing. One of the biggest safety issues I've felt personally, when I saw workers out in the field, manual laborers, was basically just having good shoes. Some of these folks would wear sandals. One of the common things they were issued was kind of rubber boots, they were good for keeping your feet dry. You know, this is a common Brazilian type footwear, but they didn't give you much protection if an ax should hit your foot. I think footwear was probably one of the biggest pieces of safety equipment that we tried to push and get people to wear, and gradually get better footwear for folks, starting from some of these people were just wearing sandals, to get them to wear at least tennis shoes and covered type footgear.

HKS: Off tape we discussed some of the personal aspects of it, that your son Noah was born there. There was a physician on staff. You had a hospital.

JCW: Yes.

HKS: And all this was free--part of your compensation, as it were.

JCW: Yes.

HKS: Clayton tells the story about, when he first got there, his son cut himself. And Clayton himself sewed him up, the stitches. It progressed substantially, as fast as that infrastructure could be built.

JCW: Yes.

HKS: What would have happened if you had a major illness or injury and you had to be evacuated to a first world hospital, as it were?

JCW: I don't have exact chronology, but basically it evolved from having one plane flight a week to having one plane flight every day. And I think there might have even have been a period, there might have been two flights on one day. The company at one point had two DC-3s. At another point they had one DC-3 and also a Fokker turboprop passenger plane. And they also had two Islanders, which were smaller, about ten-passenger, twin engine planes. So if you had an emergency, there was usually a plane available, particularly an Islander, available on site, so you could be flown to Belém, which was about a two-hour plane trip. Basically where you'd go for emergency treatment was to Belém.

HKS: But that would be free?

JCW: The plane trip would be free, right. Now with respect to the hospitalization in Belém, I'm not sure how that worked. Brazil has socialized medicine, but like socialized medicine in other countries, there's sort of a two tier system. You have socialized medicine, which is free, but there's also private practices that doctors have. The comments by Brazilians and others was that if you really want top class care, you really would go through the private network. I don't know how it is today.

HKS: Gilvary said that Ludwig had a lot of compassion for illness. He used his example of his own mother, who was in the States, and he was in Jari. His mother had serious cancer problems. Ludwig arranged for her to get in the Mayo Clinic. I guess the question I'm asking, There wasn't such a thing as a company health plan, like Blue Cross Blue Shield, like you have here at major corporations in the States, where you knew that a certain level of health care would be provided.

JCW: I never had to use the company health plan.

HKS: As the community developed, you had more and more spouses, more and more children, and those issues became more important.

JCW: Yes. I was never in a situation where I had to use medical care in Belém, for example, and certainly not in the United States. So those issues never came up with me. I basically used the same health system that everybody else used, the Brazilians and everybody else. I do recall a couple of people who had health problems like malaria and some things. It might have been Don Haight; he went to the Aschner Clinic in New Orleans, and I think Mr. Ludwig took a very active interest in that. I did get the same sense that he cared a lot about people's health and took an active interest in the upper management's situation. National Bulk Carriers, which was Ludwig's company, had a health plan, but I never made use of it, so I don't know what it was.

HKS: I'll have to talk to somebody who got sick. It's part of the philosophy of developing the town.

JCW: Yes.

HKS: I asked you earlier about whether or not you could buy liquor, or whatever, at Monte Dourado. More to find out if Ludwig imposed his morality, his sense of values on the development of the town. And you said no, not as far as you could tell.

JCW: No. I think there are some other people you could talk to and get a better sense of that. Johan Zweede, for example.

HKS: On several occasions Clayton characterized Ludwig as having a seaman's mentality. You had the ship's captain at sea, and then the captain was in charge. Clayton didn't say this, but on board ship you don't have any liquor. You can't afford people getting drunk and so forth.

JCW: That may have been something that evolved. I think when the project first started there weren't families out there. Probably that was initially a very captain's-seamen's

JCW: That may have been something that evolved. I think when the project first started there weren't families out there. Probably that was initially a very captain's-seamen's mentality, you know, in which I would probably agree with, to a large extent. You don't need people not staying on task. Then as families came in, it probably transitioned into a little different thing. Then as the town gradually became more open, and more families and so forth, it evolved where some of those strictures were broken down, just like in any normal setting.

HKS: There's the Brazilian shantytown, I guess it's fair to call it, across the river.

JCW: Yes, the Beiradao, they called it.

HKS: How did you get there?

JCW: You'd take a boat across the river.

HKS: This boat, was it a commercial boat?

JCW: Private boats.

HKS: You'd pay somebody a peso or whatever it is and you'd go across.

JCW: I was in Thailand one time, and it's very similar to Thailand, river taxis.

HKS: In a sense, the shantytown was market driven.

JCW: Very. Completely market driven. The shanty town was in the federal territory of Amapá, not the state of Pará, and I don't know the different legal issues. We were talking about trying to develop some plantations on that side for many years. Whenever we talked about that, Mr. Ludwig would say, No, we don't want to develop over there right now. It might have had to do with the fact that it was a federal territory. He didn't want to be in two different government areas. The disadvantage for us from a forestry standpoint was that it was sitting right across the river from where the pulp mill was going to be sited. We wanted to keep our transport costs low.

HKS: Sure.

JCW: And subsequently that was developed. Probably the best production plantations right now that Jari has, the eucalyptus plantations.

HKS: By federal territory, that means it's less developed infrastructure.

JCW: Yes.

HKS: Like Alaska was and Hawaii.

JCW: Exactly. Exactly.

HKS: At some point it would be able to be a state on its own right.

JCW: Yes. If they want, you know, if the federal government wants to and if it wants to.

HKS: I see.

JCW: I think I mentioned earlier, in terms of written records and what was left, I thought we did a good job of documenting what had been done. At various times, during transitions of people, there were company files that gave what the history of plantations were. We have also talked about the management information system. That's contained in file folders at Jari, you know, that keeps a record of what was done. The other interesting thing was, between the time that Mr. Ludwig sold the project, they put out a commemorative report which essentially was kind of a closing summary report on the status of the project in the end of 1981. That's a document that exists on the project, of the way things stood.

About June of '83, many of us who had worked for the new company left. We put out a series of five or six booklets about an inch thick each, which basically were operating procedures manuals. There were two of them for harvesting, there was one of them, maybe two, for management, and there were two of them for planting and inventory and control, which was my section. That was a passing over of what current procedures were, and for the new company to have some documentation. Of course, they also had Brazilians in management positions that were continuing on. But it was sort of a transition, some hard copy documents to carry on the transition.

HKS: So far as you know, are there copies in the material at Syracuse?

JCW: No. There are some other things that are available at Syracuse, and I kept a copy of what was given to Syracuse.

HKS: There's all this plot data level stuff. That's what they list. It's too technical, far too technical for a major review for this interview.

JCW: The stuff at Syracuse tends to be more technical, even to what I'm going to show you. It's not management--our intent at Syracuse was more of a scientific nature and what research had been done. It wasn't an intent to have historical archives.

HKS: Oral history doesn't lend itself to highly technical information.

JCW: Yes.

HKS: And if we could have the technical stuff put someplace, like Syracuse, and have a narrative story that sort of provides a context, then we've probably told the story adequately.

JCW: Yeah. Well, one thing that struck me, I was asking you off tape about what you did your Ph.D. dissertation on, and you said it was the history of forestry in Washington. You know, somebody could really do a Ph.D. dissertation on the Jari project.

More Lessons from Jari

HKS: Why didn't you write your dissertation on Jari? Why did you choose Jamaica? It seems to me it was an obvious thing. You had all this data from Jari.

JCW: If we go back to what my interests are, it's in harvest scheduling and economics, and also economic development in forestry. For me, Jari, I didn't think I could learn a lot new by going over old stuff. There were some harvest scheduling issues that came up during my career at Jari, and I wanted to explore those further but in another context. I looked at Puerto Rico, and I also looked at Jamaica. And Jamaica, because of a company that they had there, and working with that company turned out to be a lot better for me.

HKS: Without being cynical, you wanted to actually learn something, not just get a degree.

JCW: That's right. That's right.

HKS: [laughs] It takes all kinds, I guess.

JCW: When I first went to Jari--my wife should get a chuckle out of this--I sort of went in my mind with the intent of staying there for a couple of years and getting the experience, after my Master's degree, and then going back and working on a Ph.D. As I got into the project, I enjoyed the work, I saw that it was a real opportunity to learn a lot more. When my wife and I were married, that was in '74, and my wife and I are from the same home town in Florida.

HKS: You knew her before you went down.

JCW: I told her we'd probably stay a couple of years and then we'd go back to the States. I wound up staying there eleven years, and she wound up staying there nine years, and so I've lost my credibility ever since then. I was basically taking the experience I learned in Jari and what the operating issues were in plantation forestry and developing countries, with Jari being the case example, and having also done some other benchmarking trips to other places. I wanted to use my Ph.D. experience to get into the models and the more theoretical ways to solve those problems.

HKS: Is there a Jari experience per se that you could generalize from? Let's say you go to Indonesia, you go to Zaire, you go to some other country and you're developing something. Because you've been at Jari, are you a step ahead? Or is everyplace so site specific, the issues, the culture, the economy, plus the biology is so unique, that you really can't generalize from Jari?

JCW: I think there are some generalizations you can make, some learnings that apply to other situations. There are several situations. One situation would be, What lessons at Jari can you learn about plantation forestry and how to develop plantations? You need to pay careful attention to soils, soil mapping. Then knowing what your

production response are from those different soils, you need to spend some time on species selection. You've got a tremendous advantage that you can grow tree crops in a very short period of time. But don't assume that you want to just go out there and plant trees right off the bat. You probably want to take at least one rotation length, say six or seven years, to do the species trials and all that sort of stuff before you leap into it. So that would be a lesson I would say anyplace. Say, you might even say, at least a half a rotation length. So that would be sort of my lesson for plantation forestry.

HKS: A generic thing, worldwide.

JCW: Generic, worldwide. Another lesson, is to plan your road system carefully and be thinking about your harvesting system ahead when you put the trees in the ground. We thought about our harvesting system ahead, to a large extent, and of course, the harvesting system evolved over time. But I think the harvesting system we used, the big stick system, was probably the most efficient system for the labor costs and the infrastructure, in terms of maintenance facilities and all that. It was what I consider appropriate technology for the time. Now as time has gone on, I think there are better technologies that we should move to, and Jari is moving to.

HKS: You mean more mechanization.

Labor Question

JCW: More mechanization. I have a concern, though, that there may be a tendency in Brazil, from my perspective, to overmechanize. It gets back to this issue of labor surplus. I have a soft spot in the sense that I hate to see people unemployed, and to see them unemployed because of an overcapitalized harvesting system. So that's a concern for me, and I don't think Jari is the only place. On the other hand, to give those companies their due, in large part, they're just responding to higher hidden costs of labor, for example, bad publicity. In other words, if you get a newspaper article saying, Well, you're exploiting workers, I can't put dollars and cents, but that's a cost of having those workers.

HKS: That's in one of your papers, that labor-intensive can be seen as labor exploitive.

JCW: Exploitive. that's right.

HKS: And so if you mechanize and reduce the numbers of people, you increase the salaries of those who remain, because they're more technically skilled?

JCW: Sure. You have a lot more investment in those people, because you're all of a sudden bringing labor up who's highly skilled, who has the ability to go someplace else and get a job in that economy.

HKS: So the ones who remain on the payroll are better off.

JCW: They're going to be better compensated. They have better safety equipment and all this other stuff. But you don't have very many.

HKS: Sure.

JCW: In the back of my mind, there's this guy who's doing great, family looks healthy. But what about all the families of the other people you're not hiring, that you don't see, you know, that aren't around you? The ones that are still in northeast Brazil without a job. That's the thing that goes around in my mind, when I think of overcapitalized systems. Most of the people who would listen to this can think of a lot of folks in the world who are underemployed because they don't have the skills that match the technology that's out there.

HKS: When I read about Monte Dourado, over the years, the population bumps up and down. Twelve-five maybe was the highest figure I saw, and now it's down to eight thousand. Is that because there's less development? I'm not sure I have the numbers right.

JCW: I'm not sure either. There were sort of two populations. There was the company population, the people who were in company housing. Actually there were about three different populations that I would, if I were doing a census, try to think of. One population would be the people who were direct company employees. The other would be the population of contract laborers. And the third would be the population of people that lived, say, across the river, who didn't work for the company but were supported by the company because people would spend their money.

HKS: Service industries.

JCW: Service industries, that's the word. I want to say the population today is probably thirty-five, forty thousand people.

HKS: Is that right?

JCW: When people would come visit us, they would always ask these kinds of questions about the population. We had some numbers about how many people lived in those different categories, I believe. I don't know about the service industry category, but at least with respect to contract laborers and company employees we have pretty good statistics for those. Brazil probably has at least some census of that area. The federal territory has a census probably, and Pará has a census.

HKS: You said off tape that you had to get permission to add a porch to your house. And you had to pay for that. Are there houses in town that people construct? They're not actually company built houses?

JCW: When we were there, no. The rent was very minimal. In fact, for some time it was probably free. But then as time went on there, they put a rent on it. But they were company houses, and the idea was not to allow people just to start adding things on to these company assets. The idea was not to prohibit you from doing something, but to make sure that whatever you did followed some reasonable architectural guidelines, and engineering guidelines, for structural integrity to do it.

HKS: How did you accommodate new labor? Was there a barracks situation?

JCW: There were barracks out in the field at different places.

HKS: O.K.

JCW: Permanent barracks. There was a village built up on the plateau near the airport. There was another one constructed out near the nursery in Sao Miguel. There was one constructed down near the kaolin plant. The idea behind this was to allow laborers to bring their families in there, and settle, and have their offspring become future laborers for the project. We were concerned, we really wanted to establish a town there. This was not a kind of a cut out and get out kind of mentality.

HKS: O.K.

JCW: This was to try to establish a permanent enterprise. A Brazilian mentioned to me one time that for somebody coming from southern Brazil--it was just about as much of a shock coming to where they were as it was for somebody from the United States coming or living there in the middle of nowhere, so to speak. Our concerns were to try to develop a town, have schools and things, where people would want to raise their families. The company would have a labor pool, and they would have a pool for having service industries and all the things that comes with a city. I think one of the disappointments of Mr. Ludwig and the group was that the government in many ways didn't want to accept some of the responsibility in helping us develop a permanent town there. In other words, Mr. Ludwig had to carry on his shoulders many of the infrastructure things that one would associate with government providing services because of the taxes that industry and people pay. That continues to be a problem, even for the new company.

HKS: Clayton mentioned how Jari even had advisers to teach the locals how to have gardens, what vegetables would grow well there.

JCW: There was a fellow named Anel Guevara, who was a native of Panama. Anel had several jobs over the period of time. There were some outlying villages. Now a village here was about two houses, or three or four houses, from the old Brazil nut collection days. Anel would go out and work with these people about how to grow, how to raise vegetables and produce to sell in Monte Dourado, and we set up a market in Monte Dourado. So Anel was actively involved with that. A lawyer by the name of Ana Moura, that was part of her job, although she was also responsible for working with contract laborers and doing a lot of that. We had one or two social workers, who would also work with the families in the Silvavillas, for example. So that was some of the things we were trying to do.

HKS: We've been talking about sort of the infrastructure and Monte Dourado and the costs of labor and kinds of labor. Anything more that needs to be added? In the early photographs, before any of the street trees grew, it looks like it was laid out by a military regime. But you look at the photos now, at least from the air, with green trees all around--

JCW: Well, things grow pretty fast. That's an advantage. The photoperiod at the equator was an important factor. That really wasn't a problem in terms of fruits, because they were tropical fruits. Now granted you couldn't grow apples and things like that. With vegetables, the photoperiod and the heat gave some problems for some of what we would like to have. Americans at least were accustomed to green vegetables. So there was a difficulty in getting green vegetables. There are some lettuce varieties that you can produce there. I would say that the biggest lack for people--this is true of Belém, at the big markets--is green vegetables. The Japanese Brazilians were really good at growing things, green vegetables and so forth. But the photoperiod limited what you could grow. You couldn't grow broccoli, for example, and some other things. And some of us tried a lot of different things in our own home gardens, but couldn't do it.

HKS: But you never felt you weren't getting a nutritious diet?

JCW: Oh, no, no, no. Beans and rice, which is a Brazilian diet, is almost a complete protein diet. In fact, I think we probably ate a lot better there than we eat here in the States.

HKS: There was no Dunkin Donuts there.

JCW: Like right now I'm eating a Dunkin Donut. In terms of the infrastructure, I was about to say something about Ana Moura. We had different companies that provided contract laborers. We needed to understand what their cost structure was, and we needed to understand if they were following the legal requirements of Brazilian law. We established a contract labor company separate from Jari, and it was called Sasi. I can't remember what that stands for. But Ana Moura is a lawyer, and she was the one that ran that company, and along with, I think Almir Bastos was his name. That was our way of understanding about the legal and the physical requirements, logistical requirements of getting contract labor. It was sort of our benchmark. We did a similar sort of thing, and actually it was Sasi that did it, when we got into harvesting. We eventually had other contractors in charge of harvesting, just like you do in the States, contract harvesters. But we had our own company and crews, plus Sasi did its own contract harvesting, so that allowed us in a way to understand what was going on and to try to provide some guidance, some technology transfer to the other harvesting contractors.

HKS: For harvesting contractors to come in, would they have to bring their own equipment? It would seem to me that's pretty expensive.

JCW: I don't know exactly how we did it, but we financed them in terms of the big stick harvesters. One of the good things about these big stick harvesters, of course, is they're very low cost. Now all the harvesting for the native forests, which required skidders and that sort of thing, was company harvesting. The contract harvesting I'm talking about had to do with using the big stick harvesters, which was a labor intensive job, which basically involved a Mercedes truck, which was built in Brazil, a kind of standard truck in Brazil. At first we imported some of these big stick harvesters from the States, and then I think gradually we might have manufactured some of our own. I can't remember.

HKS: And so we have a community from ten to twenty to thirty or more thousand people. How many Americans were there? A hundred? Two hundred? I don't want an accurate count, but just what order of magnitude would you guess?

JCW: Of course, one thing we're talking about here is a big time span.

HKS: Sure.

JCW: So any answer I would give would be wrong for one particular time span. So let me describe the different phases of the project. There was sort of the first phase, when people came in and established the town there. That was before I got there. The next phase would have been the phase when you geared up for planting and plantation management on a bigger scale, and planting thousands, tens of thousands of acres of plantations. And getting the road infrastructure in there. The next phase was sort of gearing up for when the pulp mill would arrive, the civil engineering phase. The next phase was once the pulp mill had arrived, the start up phase of the pulp mill. And then the last phase was the running of the pulp mill on an operational basis, so I don't know, maybe I've described six phases there. It wasn't just Americans but a lot of expatriates. We had people from England, we had people from Angola, Mozambique. We had a lot from other places in South America besides Brazil. It's hard for me to come up with a number. I want to say a hundred.

HKS: That's really what I'm after.

JCW: The ballpark estimate. During the pulp mill startup, for about a year, there was a phase when we had a lot of people from Finland come there. *Jari: Seventy Years of History* by Cristovao Lins here. It's in Portuguese. It gives a list of all the different nationalities that were there. That's pretty accurate; Indonesian, Italian, he's got Indiana. I don't know if that's a state or.... [laughs] Oh, he must mean Indians. I guess that's Portuguese for Indian.

HKS: You either spoke English or Portuguese.

JCW: Yes. Like the Finns, you know, when they were there, they either spoke English or Finnish. Not many of them learned Portuguese. They didn't have any reason to learn it. It depended on who you were with. I would speak English at home, and I would speak English if I was just around Americans without a Brazilian present. But Portuguese is what I spoke.

HKS: Did your wife speak Portuguese?

JCW: She spoke enough to get done what she had to get done.

HKS: Shopping and...

JCW: Shopping and that sort of thing, yeah.

HKS: Did she work?

JCW: In the home. There was an international school there for a period of time, for expatriates. It was an English speaking school. And she worked in the library there, to help set up the library. I'm not even sure if she got paid for it. She might have volunteered.

HKS: I'm way ahead of you on the eating donuts. That's the advantage I have of asking the questions. Anything more to add about life in Jari, before we get back to some of the technical questions?

Importing Technology

JCW: Not really. Earlier we were talking about any generalizations I could make. I talked about generalizations with respect to plantation forestry. Another generalization I think you can make is a generalization that's not new, certainly not new to warfare, is logistics. I think you have to pay careful attention to logistics, and I think part of the appropriate technology is to not have technology which you can't support logistically. One of the concerns we had in developing our harvesting systems and any kind of engineering thing was the fact that getting parts was not always easy. If something broke down, you needed something that you could get the parts. Even better, you needed something that wouldn't break down, so you wouldn't need to get the parts because it would be very reliable. That's of course something true of anything in a remote location.

HKS: When you ordered equipment, did you tend to order from the States, or did you order from suppliers in Brazil?

JCW: If you could find it in Brazil, you wanted to get it in Brazil. But oftentimes, and at that time Brazil didn't have the equipment you were looking for. Caterpillar tractors, for example. They were ordered from the States, although eventually I guess we got them from Brazil. I don't know exactly how the Caterpillar tractor distributors worked, where they actually were manufactured, but I recall there were a lot of difficulties in the early years, in trying to get some specialized logging equipment in to test things, because you had to go through a pretty stringent process with the government. Is this machine made in Brazil, or something very similar to this machine? And then you'd go through all the bureaucratic hassles and say, No, this is not exactly the machine. The people doing all the haggling and arguing, of course, were people who were not directly going to use the machine. We tried to find Brazilian equipment where we could. I know for a long time, one of the problems was computers. We couldn't bring PCs in, because Brazil at that time was trying to develop their own PC industry.

HKS: O.K.

JCW: We wanted to use the latest technology from a forest analytical perspective. We really couldn't use it, because we were barred by the government from bringing that kind of stuff in. They've either caught up or they've gradually abandoned some of that, and there's a lot more free market availability of these things. They have also bought into the global economy like many of us. But we were living in a period with tariffs and all that sort of thing, not having the availability of some types of equipment.

HKS: But when communications improved, so you could call directly from Jari, you could call the States and they'd air ship a thing down and you'd have it in a week or a few days.

JCW: If you got the customs clearance.

HKS: I see.

JCW: You might have the communication links set up, and you might have the transport link set up, but you've still got the bureaucratic governmental barriers.

HKS: Your office in Belém, one of the things that they did for you was deal with the bureaucracy.

JCW: Exactly. Exactly.

HKS: Was that office just a few people, or was it a large office?

JCW: It's hard to remember that one. Fifty people, maybe. I may be overstating.

HKS: But maybe the bureaucrats--

JCW: The ones that really dealt with that kind of issue, there were probably no more than four or five people that dealt with expediting things. *Despachantes*, I think, is the Portuguese word for it, people who expedite different things. Back to the generalizations. I think you have to pay careful attention to logistics. Another thing, I think the government and you have to have a clear understanding of what they're going to furnish and what you're going to furnish. Now that's easier, obviously, said than done. We can't even do that in the United States. But it would certainly help a lot of situations. If you don't have a clear understanding, you should certainly hedge your bets and have options in case the government should renege on some of their promises.

HKS: Was bribery an issue, to get things done? As it is, say, in Indonesia.

JCW: I didn't have any first hand knowledge of it.

HKS: I'm not trying to get you into trouble.

JCW: No, I understand. I didn't have any first hand knowledge of it, but my working hypothesis, you might say, was that there were times that--it wouldn't surprise me.

HKS: A guy like Bob Gilvary who had to bring in a lot of equipment must have needed shortcuts from time to time.

JCW: It wouldn't surprise me.

HKS: It wouldn't surprise you.

JCW: No.

Jari and Economic Models

HKS: A question I should have asked earlier when you were talking about your yield tables and so forth. The mathematics of tropical plantations, the formulas and so forth, is it the same as temperate? There's no different kinds of mathematical derivations of biological properties? You had to come up with new kinds of equations. The fundamental things you have in American forestry textbooks--

JCW: You can use those.

HKS: But you had to measure different things, and the numbers are smaller, I mean, the rotations were smaller and all the rest.

JCW: In the forestry and the biometric literature, there are enough flexible forms to the equations. People all over the world have had to deal with trying to predict things a lot of different ways, and so there's some good flexible forms of equations. It was just fitting the coefficients to our particular situation.

HKS: As an economist, you think about efficiency in certain ways. Do economic theorems have to be modified when you're dealing with third world situations or socialistic situations?

JCW: What comes to your mind?

HKS: Our idea of efficiency--the hidden costs of labor and all that. Do the first world models really work in the third world by just putting different numbers in?

JCW: Well--

HKS: Or do you need a whole different set of equations? I've talked to some people who in the '60s were in Africa working for the State Department, on foreign aid. A great mistake we made as a nation was to apply the theorems of the Marshall Plan, which was very successful in a demolished first world part of Europe, but the same philosophy didn't work at all in Africa, because it didn't have a first world mentality. What else do you--how else do you have to think differently when you are in the third world?

JCW: Economics is a big profession. When people think of economists, they tend to think of the mathematical economists. Those are the folks that get the biggest press and get in the journals and so forth, a lot of times. But I don't think we can forget that economics basically is a social science.

I'm saying all this to get at your question, that in any particular institutional setting the mathematics may be the same, just like I was talking about flexible forms of equations and biometrics. How you apply those mathematics and what the appropriate mathematics to apply are, can be quite different because of the institutional setting. In

some settings the mathematics is not the appropriate tool even to analyze your situation, your economic situation that you find yourself in. What you're describing with the Marshall plan, I guess, has to do with the incentives, you know, what are people trying to maximize in their individual utility functions? Probably there were some assumptions made that the utility functions of individuals in Africa would be the same in Europe. They're not, because they have different assets to work with, they have different social heritages, and a lot of other things.

I would say in Brazil, getting specific to Jari, with respect to analyzing plantation investment, probably net present value analysis and all that sort of thing was very similar. Tariffs and, well, tariffs and taxes, that was peculiar to Brazil, and you had to work with that, which of course is part of the price mechanism, how you interpret that. I think there's a lot of the economics of working under uncertainty that we had to deal with, too, risk and uncertainty. You think about Mr. Ludwig, one of the classic assumptions in economics is it assumes profit maximization. Certainly Mr. Ludwig would say, I'm trying to maximize my profits. I mean, that's why he got into this. He wouldn't have said, Well, I'm getting into this to lose money.

HKS: O.K.

JCW: But on the other hand, I think he had some other motives. Obviously we can't talk to Mr. Ludwig to find out, but I think he wanted to leave a legacy beyond just generating a lot of cash flow. I can't help but believe that, because I think there were other places that he could have made a lot more money, and I think he's a rational person. He could have seen that. There was something that really struck him about this project, that was his love, and he was willing to continue to put money on this project in the face of some pretty big obstacles. So I think profit maximization is not the correct model to apply to the Jari project and his motives.

HKS: I suppose a good economist, like a good anything else, any other profession, is realistic and so forth. What I was thinking about when I was asking those questions is, looking at the United States, there's a group of economists who insist via the Sagebrush Rebellion sort of thing that we'd be better off if public lands were privately held, that under private ownership there's better stewardship because the market forces tend to make you want to protect your investment.

JCW: Yes. Somebody owns the resource.

HKS: That's right. If you go to Brazil with that idea in your mind, are you handicapped?

JCW: I don't know about the Sagebrush Rebellion, but I basically have believed that the free market system is not perfect, but it is better for somebody to own the resource, and they will do a better job of managing it than if everybody owns the resource, sort of the tragedy of the commons argument.

HKS: O.K.

JCW: If nobody owns the resource, the resource will be abused. There's a lot of mathematical theory to show why that is. If no one owns the resource, the resource will

be depleted, whereas resources owned by one individual or one group of individuals sharing the proceeds from that resource, that there'll be a better solution for the economy as a whole. Whether it be Mr. Ludwig owning that resource or whether it be a group of companies like it is now, that's a better solution than Brazil owning that resource and managing it as a socialized enterprise.

Government's role is to put the appropriate regulations or price taxes, taxes and tariffs, to take care of externalities. This is what I was talking about to get a good agreement with the government, the government doesn't need to be changing the rules in the middle of the game. They need to make the entrepreneurs understand what those rules are so that the entrepreneurs can react appropriately. If the government keeps changing the rules of the game as you go along, then you're going to lead to suboptimal behavior. The people are going to react in bad ways. The private sector's going to react in ways that neither the government nor the private sector is going to be happy with. So I guess that's why I'm saying that there needs to be a clear understanding what the rules of the game are between the private sector and the government, when you enter into something like this. But we know that doesn't always happen.

HKS: I realize your training in economics was less sophisticated when you were there than it is now. And you've had more time to think about it and all the rest.

JCW: Yes.

HKS: But did you ever engage in these sort of economic theories, I'll call them, with a Brazilian colleague, who comes out of a different system, has different expectations.

JCW: I'm not sure about the Brazilians; boy, this is like me saying what the average American thinks like.

HKS: Sure it is.

JCW: I would say there's not a lot of difference between the average American middle class, upper middle class, who after all are the people that are really managing the economy. To a large degree, the entrepreneurs and the managers in the economy are the middle class or upper. If you take the average middle, upper middle class American and the average middle class, upper middle class Brazilian, I don't think you could tell the difference, in terms of their attitudes towards government and the economy and what the role of government is. I often think there's a lot of parallels between Brazil and the United States in the people. We're just a little different. Obviously there are more people who are economically disadvantaged in Brazil than there are in the United States at this point in history, but we're both countries blessed with a very big resource base, forests, minerals, all that. We're both countries with a very heterogeneous population in terms of ethnic origin. At the same time we had an immigration from Europe to the United States, they were having a parallel immigration to the southern hemisphere, and that's where a lot of the immigrants in towns like Blumenau in southern Brazil, primarily German, came at the same time as my German ancestors came to Pennsylvania. There's a lot of similarities to me. I don't know that you can see there's a lot of difference in economics, philosophy.

HKS: I'm trying to develop a basis for people who will use this transcript at some time in the future, in judging the success or failure or the goodness or badness of Jari, and that obviously Jari is in Brazil. It belongs to Brazilians in the long term, it's part of their culture, but how does one measure? There's so much criticism of it. How are we going to sort this out? Not you and I right now.

JCW: Going back, it gets to the issue of multinational corporations or whatever. As we move towards a situation where companies are multinational or transnational in origin, if Jari, if Mr. Ludwig buys that property, supposedly, it really belongs to Mr. Ludwig. Now granted, he has to work within the environment of Brazilian laws, and I think that's part of the problem. We had the *abertura*, the democratization. Where Mr. Ludwig and his folks were blindsided, was the fact that the Amazon holds a special place in the hearts and minds of Brazilians. Even though Mr. Ludwig can say, Well, I have the title to this, or I have as good a title as you can get in Brazil with their various land problems with title and so forth, you're still going to leave yourself open to political pressures, outside of the economics, that say, Look, you may own that, but this is Brazilian. I think that's a problem that faces anybody, whether it be Japanese coming to Tennessee, or whether it be Americans going to Brazil, they've got to deal with that issue in some way, either by good public relations or with other things. If one supports transnational and global economics, it's a challenge for that way of doing business and the transfer of capital between things, because unless the entrepreneur can have the ownership of the resource--they don't want to be subject to the political problems, so to speak.

I'm thinking of the United States as much as I'm thinking of anyplace--one controls an asset in two different ways. One controls an asset by agreement within the community where one finds itself. In other words, there's sort of a common knowledge, this is your asset. But the other way one controls the asset, and this can go for your car or anything else, is legally. This is my car, or this is my piece of land, because I have a title in the courthouse.

The trouble in Brazil and even some places in the United States is that if the common knowledge that this is your asset breaks down either because politicians or the local community says this is no longer yours as far as we're concerned, then you have to go to the legal side of things to defend yourself, where the lawyers get involved and all that sort of thing. That's I think what happened with Mr. Ludwig. He had the same difficulties that a lot of other people have in Brazil with legal title, and because of the pressures, in part the pressures because of what I would consider a lot of demagoguery and the populist movement, he had to try to resort to some extent to the legal title, legal things. There's some real problems in Brazil as there are in other places in the world about legal titles. And the lawyers can kind of do what they want to with that. You just go before the judge. I don't think it ever got to that case in Brazil. That may have been one of the reasons that Mr. Ludwig decided to leave. But I think there were other reasons, for example, not being able to get the government to give him approval to some things about infrastructure. There were some other things that caused him to decide to pull up his stakes and to sell out.

HKS: When you were socializing with your colleagues there, or you had the consultants, say the people from Weyerhaeuser came down, and you were working

with them, did you ever get into any sort of theoretical discussions as a part of that? Or was it purely technical, how to get the job done?

JCW: I didn't talk to them. Now, my job there was to get the job done. I could have my own thoughts about this whole thing. When I faced myself every night, you know, or looked in the mirror and said, Can I live with myself? Am I doing the right thing, my feeling was I was doing the right thing because we were giving people jobs and we were developing that economy there. I really didn't discuss the philosophical issues, whether this was the right thing in the great global context of Brazil or Brazilian politics.

I think the biggest conversation I ever had about something like that was with Michael Stanton, he's at a university in Rio. It had to do with Brazilian policy about letting PCs come in. We were discussing--he is English, by the way--whether it was a good policy for Brazil to keep out imports, because the positive side of keeping out imports, the infant industries type argument, was that they could allow their infant industry to develop. I would argue on the other side, though, that as a person who needed those computers to do his job, that there was a real cost to be paid, because people were not being able to be as efficient in their individual industries, forestry or automotive, or whatever, because they couldn't bring this new technology in. It was being blocked. You were being either forced to use the old technology or inferior technology.

Once we'd moved out of Oklahoma State, where we did our data processing, we found a place in Rio. He was very good at working with us and he did some of our data processing at the mainframe computer in Rio. We got into that discussion because that affected what I was trying to get done directly. That was the government policy that was bothering me, because I felt there were better ways to do this, and I couldn't, of course, control any of it. But it was an interesting philosophical argument.

HKS: This link to Oklahoma State, does that go back to Posey coming out of Oklahoma State? Did he happen to know somebody there?

JCW: First of all we looked at Belém. There was a computing facility in Belém with an old IBM. Maybe it was an IBM service center in Belém. We thought of doing our computing there, but the computer was just so old and antiquated that our next thing was to say, Well, maybe we need to find a university facility in the United States that we could use their mainframe. I looked at the University of Georgia, VPI (Virginia Polytechnic Institute), Oklahoma State, and the University of Florida. I really didn't see any significant differences between any of those, and Clayton had ties to Oklahoma State.

We had used a consultant from Oklahoma State who'd been a professor of Clayton's and later became a good friend of mine, Professor Nat Walker. We decided to use Oklahoma State because of some of those connections. At one time we had two people working at Oklahoma State that worked for me, J. L. Albert, whom I mentioned, and Sam, I can't remember his last name. It begins with a W, but anyway, I had two people working there at Oklahoma State, doing some of the biometric data processing work. Then eventually I wanted to try to move that closer to Brazil, and particularly as the project started trying to downsize a little bit with the possible changeover in ownership. So I got in contact with Michael Stanton in Rio.

HKS: Today, with the communications, you could downlink, uplink anywhere in the world. It doesn't pretty much matter where the facility is, I suppose, physically. It mattered more then, I suppose.

JCW: I was interested in the data processing from a forestry standpoint. The company had a data processing problem with respect to all their other records, accounting records and all that. There was a fellow named Charlie Schick who worked for the company, and I think he was based out of Rio. The company was actually looking at satellite links and telephone lines, how can we use mainframes? Nowadays, this is sort of a nonissue. That's a real advantage that anybody starting a new project in a developing country, they can just go straight for PCs to do everything they do in forestry.

Forest Operations Infrastructure

HKS: Sure. There's some technical things we ought to talk about. This comes from your vita that you sent me. After '78, you were manager of Forest Operations.

JCW: It was really Forest Operations Planning.

HKS: Oh, planning. Oh. So Forest Operations itself, that's what Johan did?

JCW: I reported to Johan.

HKS: So you were his planner, in a sense.

JCW: Yes. There was strategic planning, in terms of harvest scheduling. The customer there would be Johan, it would be Clayton Posey, the people that were sort of looking at what volumes would be coming online and so forth in a big sense. The other customers I had, internal customers, were the people in harvesting and in management. What plantations are we going to harvest in the next year? Also we kept the cost control records and made the estimates of what things were costing. The foresters would send in every week what cleaning had been done, or planting, or site preparation. I had a fellow that worked for me, Akira Takagi, who was a Japanese-Brazilian, I think second generation. He still works at the project, by the way. He would compile the cost estimates, and then we would get those back out. Sort of a woodlands cost tracking system or control system, so that the area foresters would know how much their operations were costing, how many man days per hectare, how many kilos of ant control chemical per hectare, and used as a way to see how we can improve operations.

HKS: So under Johan's supervision, then, there was your program, Planning, there was Harvesting, and Management? I'm trying to look at the infrastructure a little bit.

JCW: Yes.

HKS: Who were your counterparts, who also reported to Johan?

JCW: Looking at Forest Operations as kind of an organizational chart, and this would have been in 1981, you had Johan Zweede, and then reporting in staff positions were Planning, Inventory, and Control, which was my department. It says on this organization chart we've got eleven people. I won't get into the people, because I don't quite understand all these numbers here. Then we have Administration and Support. That was Don Hoppe. He was Johan's right hand man with respect to a lot of administrative issues. Then in line positions reporting to Johan would be Harvesting Division. That was John Sessions, who is at Oregon State now.

HKS: O.K.

JCW: His predecessor had been Mac Davis.

HKS: I know Mac.

JCW: O.K. Sasi was Ana Moura that I mentioned. That was the contract labor company, sort of owned by Jari. Forest management was Robin Collins. Robin set up the Westvaco operations in Rigesa in southern Brazil, and then went back to the States and was not really satisfied with his position at Westvaco in the States. And we hired him, and then after he left Jari, he went back to work for Westvaco again.

HKS: These numbers, these small numbers here, suggest total employees. There's forty-nine hundred total under Johan, and then twenty-four hundred here. That's a lot of folks.

JCW: I think those ones in brackets are contract laborers.

HKS: O.K.

JCW: We were talking about the organizational structure in Forest Operations, and we were trying to interpret the number of people as of 1981, end of '81, when the transition from the old company, Mr. Ludwig's company, to the new consortium of companies. Under Forest Operations there were 684 payroll employees, there were 4931 contract employees in that organization. Most of those contract employees were either in Harvesting or Forest Management. There were 2477 in Harvesting, and there were 2443 in Forest Management.

HKS: Now the people in Harvesting, I know what their job is, but in Management, that's planting, thinning. What else did Management personnel do?

JCW: Some cleaning, weeding, for example, with machetes and so forth, they would go in the first year and the second year and clean the plantations.

HKS: Back to Forest Operations, Planning. Your job was to coordinate forest management and logging plans with bleachcraft, market pulpwood. Coordinate with who, is the question I'm asking. This is within the company. Right?

JCW: Usually with Johan and Mac Davis or John Sessions from Harvesting, we would attend a weekly meeting down at the pulp mill, where Ted McCrocklin was the pulp

mill manager. We talked about wood deliveries for the next week, and plans for mill shut downs, and all that sort of thing. So we would coordinate with the pulp mill, their production. Which is a very common thing in pulp mills, to have a weekly production meeting, and usually the people in woodlands are part of those meetings.

HKS: I don't know very much about pulp, but it strikes me as significant that you had three basic species. There would be a desired recipe, I'm assuming, a percentage of eucalyptus, pine, and so forth.

JCW: Right.

HKS: Was that a difficult thing to maintain, the flow, species by species?

JCW: If you start with the marketing of the pulp itself, this was basically market pulp. Everything started with the marketing and sales people. They would develop a customer base, and the customers would want a certain type of pulp. I think we had two or three grades of market pulp. We had what was called the pine pulp, we had the gmelina pulp, and then we had what they called Jarilyptus, which was a kind of a eucalyptus pulp. That was mainly in the planning phase. So it started with the marketing, and then the pulp mill people had to schedule their production of what to produce when. Then we in the forestry had to figure out how to deliver the appropriate amount of wood, during the year, of those species.

One of the issues that concerned us, in coordinating the delivery of that wood, was the wet season versus the dry season. Typically gmelina, which was the premium one of our pulps, it was better if it could be produced in the dry season, because of the type of soils. Some of the soils were very difficult to harvest in the wet season. On top of that, if you got out in the wet season, you could cause harvesting damage to those soils. So if you were looking at it from a woodlands perspective, the ideal thing would be to produce pine pulp in the wet season, and produce the gmelina in the dry season. But that was not, of course, what your customers necessarily wanted. There were the coordination issues in determining what harvesting sites to pick, and how much wood inventory you needed. On top of that, we were using a certain percentage of native species in some of our pulp. In coordinating the native harvesting and doing the selection of the different native species--I think there were about sixty different native species we had determined could be used.

Another part of the weekly process was working with the lab technician at the pulp mill, Beatrice Redko, who was doing some of the testing to see if new native species could be added without harming pulp quality. There were oftentimes disagreements between Ms. Redko and the mill manager as to whether it was an appropriate time to try to move in a new species, the risk involved in quality and all that. And as in many pulp mills, there are oftentimes disagreements as to what, if you have a pulp quality problem, what is the source of that problem. Oftentimes they looked for the wood to be the problem, but other times it could be that there's a problem in the mill itself causing contamination. So those were the kind of things that got discussed at the weekly meeting.

HKS: I'm assuming that in the world market that this stuff was sold into, there was another layer of customers, and they had a preference. Did the mill operator,

management, get a message from the paper industry in Sweden, they want so many tons of gmelina pulp delivered by a certain date? Then that would go out to you?

JCW: We were completely out of that loop. Our customer was the pulp mill. Now the pulp mill would find out from marketing, to do their production planning. If marketing said, Well, we've got orders lined up for gmelina pulp, then the pulp mill has to figure out how they're going to produce that gmelina pulp. One of the ingredients to that production is to have the gmelina there to produce it. Then we would try to work through how are we going to get that gmelina to them, and send them the appropriate signals to say, Well, we're going to try to get it. But if you can send signals up the line and say, It's difficult for us to get gmelina this time of the year. So can you and marketing and sales, maybe, work with the customers and reschedule things? Or maybe we need to have an inventory of pulp someplace.

On top of this market pulp is a very cyclical type business, where prices go up and down. It's a low value kind of product, as pulp derived products go, and a commodity. So that adds on to the scheduling problems of the marketing and sales side.

HKS: It must be significant as time went on, and you phased out gmelina, in terms of responding to the world market.

JCW: We didn't phase out gmelina while I was there. We were still producing a lot of gmelina.

HKS: I'll put it a different way. You didn't feel under some kind of pressure, or you weren't disgusted after one of these weekly meetings--those people in marketing have no sense of where pulp comes from. It comes from the ground. They were selling stuff that you couldn't produce. You didn't feel pressures like that?

JCW: No, not in the short-term period. It was, it was the day to day timing issues, or week to week timing issues. I do think one of the significant sort of strategic things that we faced, though, was the limitations of gmelina as a species, given our soils. Here we had a species that we had really marketed. That was our marketing thing, gmelina is our pulp. It had a lot of good properties and so forth. To have to go to the marketing people and say, Look, we need to think about this, because we can only produce a certain amount of gmelina. Or if we produce more gmelina, our productivity in the forest is going to suffer unless somehow we can come up with some better genotypes and some other management strategies. So there were some strategic marketing issues with respect to being able to grow the kind of trees that they wanted, that were discussed, and gradually led to the demise of gmelina, because it was really driven by the forest and what we can produce, as to what we can produce in the forest and what we can sell in the markets.

HKS: Gmelina was the pulp that was desirable because it's clean?

JCW: I'm not the best person to ask, but it's a very white pulp, short fiber, like cottonwood. One of the favorable characteristics of it was that it had a fiber that, for its shortness, was fairly strong. Most short-fibered pulps are not very strong. The fibers collapsed in the processing sort of like you'd think of a straw. If you have a bunch of

straws together and the bonding is just between the straws and the straws were still circular, they're not going to have as much surface area to bond. But if those straws were to collapse, there's going to be more surface area to bond. I think gmelina had some kind of a property like that. All of this can be documented based on pulp trials, and there's a lot of pulping that's been done with gmelina, as I say. Other people are now using gmelina.

HKS: The technical question could be answered by going to any good library.

JCW: Or talking to somebody who's currently processing gmelina.

HKS: But your marketing people would have preferred that gmelina had been a good species?

JCW: Right. Eucalyptus is a good pulp, too, and that's what they're growing now, but gmelina had some characteristics that were in some ways favorable to eucalyptus. Now probably in some other ways it was unfavorable to eucalyptus. We were hoping it would have its own niche in the world markets. But then you ask yourself the question, If you can't produce a lot of it, do you want to spend a lot of energy trying to develop a niche for a very limited amount of supply that you can produce?

I think the company after Mr. Ludwig, and for the year I was there, and then for a few years after that, they had not given up on gmelina. They felt that with more intensive management of gmelina, they could really produce a lot more per hectare, even on some poor soils. And who knows? Maybe if they had kept at it with better genotypes.... I wasn't there to observe the reasons, they've now adopted a strategy of eucalyptus. One of the advantages of eucalyptus is it's not as site sensitive. There's a lot more genotypic variation that can be taken advantage of for different sites. There's a lot of knowledge about eucalyptus in Brazil, and the management of it, and what works and what doesn't work. Whereas with gmelina, you're sitting there with a species that you're one of the few persons that's working with it. So for whatever reason, the strategy right now appears to be to go with the eucalyptus as the market pulp of choice.

HKS: To carry that a step further, to work with native species would be even more of a gamble? I mean, gmelina was a tough enough thing, because no one really knew anything about the local species.

JCW: Yes. But the advantage, you had a relatively cheap source of wood. The cost was just the cost of harvesting it. You had three uses of the native species. You had fuel, you had lumber, and you had pulping. Not every native species could be used for all three of those things. In fact, most couldn't. Some could only be used for fuel, there weren't any markets for lumber. Everything that could be used for lumber or pulp could be used for fuel. There were some of the fuel species that could be used for lumber, and some of the lumber species and some of the fuel species that could be used for pulp. So the trick was to try to find the highest and best use for those different species. You had a cheap source of fiber, and you wouldn't develop a pulp for this native species, but you would blend that in with the other without sacrificing the quality of your Jari pulp, your gmelina pulp.

HKS: Were you able to do this testing at Jari after the mill was put in?

JCW: Yes, after the mill was put in. We probably have some of the best data on these different native species in terms of their pulping qualities. I haven't kept up with that. I think there's some other projects that were looking at that, too. But of course, now I think rightfully so, concern about using the native forest, what the role of the native forest is for biodiversity versus wood production, maybe this is all a moot point. Although we did also have native species trials where we were growing native species, too. When I visited Jari recently, I saw some Brazil nuts that we had planted back in 1970 down in Munguba near where the pines were planted. Those are now thirty-six years of age. And there are places in Brazil where they have plantations of Brazil nut trees. These Brazil nut trees that I saw that are now thirty-six years of age are about two feet in diameter. I think you can produce Brazil nuts in about eight years. We interplanted Brazil nuts in some gmelina plantations. And I don't know what's become of that, where we planted the gmelina and then we planted Brazil nuts at a wider spacing, with the idea of perhaps having Brazil nuts above and the gmelina plantation below. What I'm trying to say is we did have planting trials of native species that were established. Currently they also continue some of those trials.

HKS: Most of this is hearsay on my part, but Johan is managing in Belém the Tropical Forest Foundation project.

JCW: Yes, I know that.

HKS: By my understanding, I would call it low impact silviculture as opposed to plantation silviculture.

JCW: Yes.

HKS: Do you have any sense of does that work? Can you supply pulpwood to a mill like Jari?

JCW: I think it would, I think it has a niche. I think that it could be done. I've seen one of the videotapes that Johan has done on that, with the Tropical Forest Foundation. He's testing the operational feasibility of doing that on a small scale. I think the next step, at a place like Jari, or elsewhere, would be to say, Now, how would we fit this into our operation plans, given our other sources of wood? I can easily see a situation where you would have plantations as part of your wood mix, but you would also have native forest. Now there are some problems. I mean, you want to maintain diversity of all these different species, and you've got three hundred and fifty different species. How do you bring these things in and do the merchandising and all that? It really comes down to wood costs. Can you deliver wood fiber from that silvicultural method, at a competitive price to the mill? It depends on a lot of things.

HKS: The price of market pulp is significant in land management. That's really the end product.

JCW: Yes. The model I would think of is you would probably want to look at some lumber. You'd want it to go to the highest value use. If you found these as lumber, you

want to bring them in as lumber, if that was the highest value use. As an interesting aside about the highest value use for the native species, I've heard Jari criticized in the popular press, Well, it's a shame to burn up these beautiful tropical hardwoods that could be used for lumber.

HKS: Sure.

JCW: There are a couple of problems with that. Many of these species can't be used for lumber because they're so dense. The other reason they can't be used is they look beautiful on the outside, but they've got a lot of rot and decay on the inside. But another reason is because of the high cost of fuel in Brazil; we did some calculations one time that showed the highest valued use in terms of economic use was for fuelwood, not for lumber. Which is a surprise to a lot of people. We're somewhat shielded in the United States from what a lot of other countries encounter in terms of energy costs.

HKS: Right.

JCW: That's an interesting spin; wood as a fuel is a pretty valuable commodity. Now, the other criticism, when I think of a legitimate one for discussion, is maybe the highest and best use for those trees is standing, because of their contribution to biodiversity and so forth. But getting back to what Johan's working on, my own personal opinion is that he's doing a good service by trying to look at some sort of intermediate, where we can not only get some of the aesthetic and biodiversity benefits, but also try to tap into some of that resource for some cash returns for that economy, from foreign economy.

HKS: At some point, this becomes philosophical. What right do we have to do any of this, anyway. That's what you read in, I'll call it the environmental literature, without defining what that is.

JCW: That's right.

HKS: The Amazon should be a preserve, like Alaska should be a preserve, or whatever.

JCW: Yes. We know that it becomes real philosophical about what right do we even have agriculture in the southeastern U.S.? Maybe we ought to just all go back to Europe. You can get all kinds of philosophies.

HKS: I know. Our federal land managing agencies are supposed to manage the land to return them to their natural state. And natural, of course, is not defined. Is it pre-European? Is it pre-human? Is it pre-Ice Age? Reintroduction of fire, and all this natural stuff. Natural is somehow better than unnatural.

JCW: Yes.

HKS: So the law now says that officially we are not a part of nature, which is an argument that environmentalists say is not true. We're part of nature. We should

behave like it. But the law says, or the regulations say that what we do is unnatural, so we have to undo what we have done. My students talk about this in seminar, and they get about as far as you and I are getting right now.

JCW: That's right.

Internal and External Markets

HKS: Any more to say about coordinating forest management and logging plans? Because the next topic is, you coordinated the hardwood sawmill, internal and external markets.

JCW: We basically had a program where we would go out and inventory a native area, and we would determine when we wanted to plant that area. Well, first of all, we'd determine whether we wanted to cut the area, based on its soils and how far away it was from the mill, and so forth. And determine when we wanted to cut the area, because when we cut it, we wanted to establish plantations. So the native wood came in because as we cut the area, and this is after the pulp mill had gotten started, we would bring the wood in and use it for fuel, or lumber, or pulp, for the hardwood sawmill or for the pulp mill. That was a harvesting effort in its own right.

HKS: When you talk about the hardwood sawmill, for internal use, it seems to me that a pine stud is a whole lot more easy to use than a hardwood stud. Was there any thought at all for growing pine to at least stud size?

JCW: For our internal use, there were enough soft species of hardwoods to use. It continues to this day. We had one person in research assigned to developing a wood sample library, a *xyloteca* as they say in Brazil, of wood samples and wood characteristics and all that sort of thing. In fact, we sent information up to Syracuse about all the wood, wood work that had been done to that date. I think we sent even a box of samples up to Syracuse, including whether it could be used for lumber or whether it could be used for.... In Brazil there's been a lot of work done in that respect, so we had sufficient species that could be used for studs and were good for carpentry purposes.

HKS: One of the things you wanted to talk about earlier, and we only touched on it a little bit, was comparison of silviculture in Jari to silviculture in southern Brazil. I'm not sure what the significance is, but let's talk about that as much as you want.

JCW: The period of Jari I'm referring to is the period from say '72 to '80, and to some extent even today. At Jari we took an extensive approach to management in silviculture, very similar to the United States in the sense that you would go out and you would clear an area, you would plant it, you would weed it to the extent that you needed to liberate the trees and grow them. In southern Brazil they took a more mechanized approach, a more agricultural approach to it. In part that was because of the nature of the land base they had to work with.

We were working with a land base which was primarily native forest. Some of the mechanization that was done early on up at the airport caused soil damage. I think the

cheapest and the best way was to burn the area, leave the native stumps in place, hand plant it, hand clean it, and so forth. Now, when it got to the second rotation in Jari, on some areas, we would start windrowing again to try to clean up--we started getting ready for a mechanization phase, where we could mechanize. And as time has gone on, it's evolved to where things can become more mechanized, as in southern Brazil.

In southern Brazil, a lot of those plantations were established under an incentive program. Brazilian tax dollars paid for the establishment of those plantations. Until the very end, we didn't really take advantage of any of that. Or maybe we couldn't. Anyway, we didn't get those kind of subsidies that they did in southern Brazil, plus the land base they were working with many times was degraded agricultural land. It was second growth forest, or second growth bush. What you see about plantation forestry in southern Brazil started off with where Jari is sort of today, with the ability to do mechanization.

We were down the evolutionary ladder a couple of steps in terms of silviculture. Sometimes when we had visitors from either southern Brazil or from the United States, who would look at our situation, I think we were criticized. The benchmark was southern Brazil, neglecting to look at what was appropriate for our situation was a little different from what was, what the land situation, and the incentives, and the money being given in southern Brazil were.

HKS: As the enterprise shifted from being an American operation to Brazilian operation, the Brazilian experience in southern Brazil would tend to be applied because that's where the internal expertise was coming from. It would have more influence under Brazilian control than it did under the U.S. control.

JCW: I think that's in part correct. I think also it was partly because of the evolution that I described. If you had spent your money with the mechanization at the front end from that native forest, pulling up those native stumps, you would have spent a lot of money. Whether you were Brazilian or American or wherever your technology was coming from, I think it would have become very apparent that the net present value would be a lot lower by having to incur that up-front cost of windrowing and everything else.

The other issue is, when you're doing that kind of windrowing, you're doing a lot of soil disturbance and compaction. In order to move these native tree stumps and so forth, you're going to be compacting. Those tractors are going to be on there a lot bigger period of time. So I guess what I'm trying to say is, as there was more Brazilian silvicultural influence in this--and the Brazilian plantations in the South, in technology, were evolving during this period of time, too--it would be natural for more of that to take place.

But I think the other thing that happened was that we were ready to do it because we were in second or third rotations. If you were to talk with Robin Collins, he could give it a very unique perspective, because here was a person, Robin, who had worked with Westvaco in their plantations in southern Brazil. He came to work for us with that background. He came out of a whole different setting, so I remember us having some discussions internally, in forestry operations, talking about, Should we mechanize more

than what we're doing. Beginning in about 1979, we started doing some windrowing again on some of the second rotation stuff, trying to prepare ourselves for more mechanization and less labor intensive approaches to the problem. We never did that even in subsequent years to the first rotation in plantations, because of the high cost. High cost not only monetarily but the high cost in terms of topsoil damage and that sort of thing.

HKS: You've said, in one of your papers, that broadcast burning is probably the single most effective technique for site preparation in the humid tropics. Given the tremendous negative publicity, the satellite imagery, everything picks up all these fires in Brazil--were you concerned with that?

JCW: Concerned with what, the publicity?

HKS: The publicity.

JCW: No.

HKS: It was the best way to do it, and that's what you did. The general perception is that this is a bad thing for the Amazon, all these fires. This is the way it's portrayed.

JCW: Well, let's dissect that. Why do you think that people think that's a bad thing?

HKS: I'm not sure why. Maybe it's just symbolic of the development of the Amazon, and anything that develops the Amazon is bad.

JCW: I think that may be the case. I guess what I'm saying, if you're against cutting down trees or burning trees, anything you do, whether to establish plantations or grasslands, or whatever, is bad. I'm not talking to you, but you could just end the discussion there. Now given that you are going to establish plantations, or grassland, or whatever, I stand by the statement, the most effective site preparation method in that situation is burning. One way to look at that empirically, if you look at slash and burn agriculture, that's what the local folks use.

HKS: Sure.

JCW: Even if they can go to somebody who has a tractor, they don't say, Well, hey, come on over and plow my land up here with the native forest, where there's slash and burn. Now, I know that they don't have access to that, but I would say even if they did have access to it, they're going to determine that's not the cheapest way to do it, it's not the best for the site, for the subsequent crop, because they're going to go in and mess up the topsoil, you're going to compact the soil. I stand by the statement that the single most effective way to do it is to burn it. You've got all that ash layer, which is fairly basic, and you're dealing with acid soils to begin with, so it provides some buffering capacity. Whether it be trees or manioc, it's probably the most effective way to do that job.

HKS: I'm thinking of the mess I've got in my yard in Durham because of the hurricane damage. It's going to take a year before that stuff is dry enough to burn. Did you knock it down one year and burn it the next, or what?

JCW: If you didn't let it sit, if there was no more than about a two month gap between when you did it, or a three month gap between when you did it and you burned it, there wasn't any problem, even though some stuff had greened up. There were two issues. One would be, you would want the wood to be dry enough to burn, the vegetation, on the one hand. The other side of it was that you didn't want too much vegetation to regrow, to sprout back, because contrary to some popular literature, and people that have field experience, no matter what their viewpoint about burning or not burning is, know that when you cut in the tropical rainforest, it comes back like gangbusters. Now it's not maybe the same stuff that was there before, but there's a lot of vegetation that comes back, unless you do something. So if you did it within two or three months of clearing, you had no trouble burning. There was enough biomass there.

HKS: It was dry enough.

JCW: It was dry enough.

HKS: You could ignite it with a reasonable amount of diesel oil or whatever you put on it.

JCW: The method we used was, for the most part, sticks that were about six feet long and they had burlap of about one foot long wrapped around the ends of them, and they were dipped in kerosene. And you would start a fire by going around the area and torching it, and it would burn, so that the actual fuel oil was just to get it started. Which is no different from controlled burning in the United States or many other places. You didn't have any trouble burning it.

Return to Jari

HKS: You've been back to Jari in April of '87. You were a consultant?

JCW: Yes.

HKS: I don't know if you were still in grad school.

JCW: I was.

HKS: So they, they paid you, they hired you, in a sense, to come down and do something?

JCW: Yes.

HKS: And that was just to--

JCW: My report was about the growth and yield system and just to kind of give my evaluation of some silvicultural things and like that.

HKS: You'd been gone five years.

JCW: Yes.

HKS: To see how things had progressed.

JCW: Yes.

HKS: Were you generally pleased, or satisfied that the work you had done was being continued?

JCW: Yes. I think they were progressing. Consultants. I always felt when consultants would come down, when I was working there, you were paying them to tell you what you already knew, or you were paying them to be your spokesperson because a prophet in his own land, you know, can't work. So you had to have them say what you already knew. Or you were giving them all the information so they could write reports and make money, O.K.? So I didn't really want to be that kind of a consultant. All I did was to go down and give an independent opinion of what I saw, given my perspective of being there, and I felt like they were going down the right path.

I was a little concerned that from a species standpoint they were deciding not to develop pine very much any more. They were going straight to either gmelina or eucalyptus. I believe that pine has a place in plantation forestry at Jari. I think it grows well in poor sites. I think the lacking thing is that more genetic work has to be done with it. The company had a seed orchard, still does, I guess, at a place called Morado Novo in Minas Gerais, with pine jointly set up with Weyerhaeuser, and were going for first generation improved seed, based on genotypes or phenotypes that have been selected there at Jari. If you go to those plantations, you can see a tremendous amount of genetic variation. So I just feel like pine is the species that needs to be continued, looked at. They were I think mainly for cash flow reasons, maybe for some market reasons, going away from that.

HKS: Pine just doesn't grow fast enough? Is that the problem?

JCW: Well, first of all there are few tropical pines, that is, on the equator. *Pinus caribaea hondurensis* is not one of them. Its native range is in Central America. There's some photoperiod issues involved. You get foxtailing, growing on the equator. But there's enough variation. We had some providences that did real well. Originally we thought the mean annual increments would peak at about sixteen or eighteen years of age, and we could grow solid wood. But what was happening is, it was peaking earlier than that, at twelve years of age. I'm sure it was genotypic. The other part may be nutritional, maybe based on some work we're doing in the southeast with forest fertilization at mid-rotation, there may be some stuff that could be done to keep those things pumped up to grow longer. But I think most of it was genotypic. So what was happening, you were getting an MAI, peaking at twelve years of age, which some people might say, That's great! But on the other hand, it precluded you from growing solid wood products.

This is based on some work done at N.C. State with loblolly pine, which is not what we grew. You get tremendous growth rates of loblolly pine in southern Brazil, but

that's partly because they have fairly cool nights compared to us up in the equator. So there's photoperiod, there's temperature, a lot of technical issues. But I think with proper genotypes, you could do a lot better at Jari, and there are places that are continuing to grow pine in the tropics. CAMCORE, which is an international tree improvement effort with tropical pines, based out of North Carolina State, continues the work for improvement of families and species that'll grow in the tropics. Back to my consulting, that was one of my criticisms, that I suggested they continue to look at pine.

HKS: But the rotation is twice as long as it is for eucalyptus.

JCW: Yes.

HKS: Economically it's a real question.

JCW: That's right. But on the other hand, we talked about in your tool kit, you should have a lot of different genotypes and species. If you were thinking about expanding to different products, if you could get better genotypes, you might go to solid wood products from pine. Oriented strand board, you know, there are all sorts of things. I just feel like it's a species that has a place. But you're right. That was the main reason, it's got a longer rotation. And it required more silvicultural inputs. It was a very logical reason they went to eucalyptus, because it is a shorter rotation. And there was other technology out there with eucalyptus.

Sale of Jari

HKS: You've talked in a variety of ways about the transitional period in '81-'82, when you knew that it was going to be sold, and you were making, at least you were psyching yourself up for this shift to different management. At the time did you talk about the shift itself, whether this was a good thing or a bad thing? What I want to get at ultimately is, did Ludwig get rooked by the Brazilian government in this?

JCW: I can't answer that question. I never did even hear what the final selling price was, so I don't know.

HKS: Bob Gilvary is very angry at Brazil. Clayton is not. I'll put it that way. So with different people, different vantage points, different philosophies of life perhaps?

JCW: Yes.

HKS: I'm not trying to create an argument here, but there's so much in the literature that Ludwig lost his shirt.

JCW: Yes.

HKS: Clayton says no. Gilvary says yes.

JCW: I think from a strictly investors' point of view, if this had been a stock company, or if you look at Mr. Ludwig trying to maximize, yes, he lost his shirt. He did lose his

shirt, I'm pretty sure. I don't know the actual financial numbers, but he sank a lot more into that project than he ever got out of it, O.K.? He didn't get very much for the asset. And you could also say that the Brazilian government and the consortium of companies that bought that were in a pretty good negotiating position to buy the asset.

HKS: Because it had to be sold.

JCW: I guess it had to be sold. I don't even know if that's true. Mr. Ludwig certainly came to a point in the road where he decided it was time to get out. But I don't know what his other options were.

HKS: O.K.

JCW: So from that point of view, I agree with Bob. Now whether to be angry or not about it, I don't know. If I take a sort of a historical perspective, in the long run scheme of things, as we're only on the surface of the earth a very short period of time.... And I put it in the perspective of the political situation in Brazil, the opening of democracy and the way Brazilians feel about the Amazon, and all that sort of thing, I think it was a logical thing to happen. I mean, you could sort of see the handwriting of history, you know, it was just a very logical thing to happen.

I read a book by Frances Fitzgerald, I think, called *Fire in the Lake* about the Vietnam conflict. Her perspective was that what happened in Vietnam was kind of logical progression. The U.S.'s concern about the domination by Russia, or China, of Vietnam, it wasn't going to happen, because ethnically and everything else, the Vietnamese had always seen the Chinese as an enemy. But we really didn't take that perspective. Now whether you disagree or agree with the Vietnam conflict, that was her perspective, that it would in the long term of history--well, it's kind of been borne out. You know, you see what's happening in Vietnam right now.

I kind of take the same long run perspective with the Jari project. I think it was in the cards that the thing would go the way it has. What's happening now, as I understand it, the company is looking for other partners, multinational partners, to work with them in further developing the project. So here we're coming full circle. Maybe not full circle, but at least half circle, you know, with the whole global economics and all that sort of thing. So it was probably inevitable that what happened happened, eventually. Now when it was written in the cards, I don't know, but I think it was inevitable.

HKS: What I remember from Clayton's interview, and on this aspect a lot was off tape, because he wasn't sure how much he wanted to say, because of the confidences he had dealing with Ludwig in a way that most people didn't, when he went to Stamford.

JCW: Yes.

HKS: First of all, it was always to be sold to Brazil. That was in the original plan.

JCW: I don't know that.

HKS: O.K. So that in itself was not a defeat. The timing was. When they had the oil boycott, and the price of energy went up, and 94 percent of Brazil's energy is imported and all of that--they were not capable of following through on the master plan to get a World Bank loan. To repeat, first of all, it was always planned. Two, Brazil was to apply for a World Bank loan. When the Brazilian economy went in the toilet, because of the oil boycott, this no longer became possible to pursue. Now, one of the reasons the Tommy Thompsons and so forth were brought in was to give credibility for the World Bank loan. They would need outside experts to vouch for it, not just the local people.

JCW: We had a lot of consultants at different times, for getting different loans. World Bank was one of them. I think there might have been some others. I don't know. I can't recall. I recall the consultants more than I recall what loans they were after.

HKS: Here is the clincher. The analogy Clayton used, you buy a house for a hundred thousand dollars, you pay ten thousand dollars down. You have a ninety thousand dollar debt. You sell the house and you get your equity back, but the debt is transferred to the next owner. And it's Clayton's position that most of the money that Ludwig invested was borrowed money and that was the debt that Brazil was to assume. And it ultimately did. That he didn't really lose much of his own money. Does that surprise you, that it could have been that way?

JCW: I know there was a lot of debt that the new owners did assume.

HKS: The building of the pulp mill was a loan to the Japanese government from some international monetary fund or something to create employment. So the pulp mill didn't cost Ludwig any money directly. He had control of the debt; he transferred that debt to Brazil. That doesn't sound far-fetched to you.

JCW: No, it doesn't sound far-fetched, but then of course, it begs the question about how much other money came directly out of Mr. Ludwig's pocket. How much money did he get for the asset at the end of the day, when he sold it? And what's the net present value, or what's the internal rate of return on that transaction? And my working hypothesis is, it was either negative or very low. What I think you're saying Clayton is saying is that, where there's a lot of people who think that the amount that came out of Ludwig's pocket was a tremendous amount--

HKS: The billion dollars.

JCW: A billion--it may not have been that much because of the World Bank loan, and that leverage.

HKS: And so the two hundred million it was sold for might have been the actual equity that Ludwig had.

JCW: Might have been.

HKS: Clayton assures me he'll never really reveal, for whatever personal pledges he made to Ludwig or whatever, what the numbers are, but he said that it's just wrong. He did not lose his shirt.

JCW: Yes.

HKS: Bob Gilvary believes he did. I can't remember whether this is on tape or not, but the only way he'd ever go back to Brazil, he used to think, was as a paid mercenary. [laughs] Well, you know him in a way I don't know, that probably sounds like something he would say.

JCW: Well, he'd be kidding, partly, too. [both laugh]

HKS: Partly.

JCW: You can tell how much of that was kidding and how much of it was true.

HKS: Well, he said he's mellowed a bit. He might go back now, without a gun.

JCW: I'd say this to Bob, obviously in front of him, because I wouldn't say it on tape otherwise, but I think Bob mellowed over time. We all mellow over time.

HKS: The technical part of the investment, the part that you worked on, was successful in that you learned a lot, it became possible to clear land. Plantation silviculture works in the Amazon, technically.

JCW: Yes. I think if a person were to go back to the Jari project today--as I say, I was back there in October--they're in a great position from a silvicultural standpoint, they're developing genotypes there that are successful, on that forest, on that land base. I think it can be made successful. I think it is.

HKS: I don't have the bibliography in hand, but there were articles in journals, like the *Journal of Forestry* during the time you were there, in the '70s, that said that this was bad science, it couldn't be done--all the failures. Maybe it was the gmelina and chancres, but it was presented as a scientific disaster, like Fordlandia was.

JCW: Yeah. I don't remember there was an article in the *Journal*--there were some articles in the *Journal of Forestry*, but I don't think any of them were that negative. They were more balanced. Certainly the Fernside and Rankin article, and in the popular press there were some negative things. Of course, there were some good things in the popular press, too. It depends on kind of which side you are on.

Let's talk about applied industrial science, O.K., meaning science whose benefit is to try to make production decisions and investment decisions. Then you talk about just science per se to learn new things about the way things work, to eventually develop some production functions. I think that the science practiced at Jari was good science in that latter sense. If you're talking about applied industrial science, it was good science, but there was not enough time. More science should have been done before some of the investments that were made. And I lay the blame, if there's a blame to be laid in that, primarily on Mr. Ludwig. Mr. Ludwig wanted things done quickly. The managers did them quickly, so you paid they price for that.

HKS: O.K.

JCW: You make riskier decisions. And so you wind up paying more, you make mistakes, you know. It's the old issue of, when do you get off your butt and start doing, based on the information you have? I would argue, at least from my risk perspective, I would have wanted to sit on my butt a little longer with the information before I made some of the decisions that he made.

HKS: So if Weyerhaeuser had done it, a stockholder company, they would have gone on a ten year pilot project or something.

JCW: Yes.

HKS: Cleared a thousand acres or whatever it would take, have a nursery and actually show that it could be done.

JCW: Yes. If their goal was to develop a long-term, sustainable plantation thing. I'm not talking about Weyerhaeuser, but we know that there are companies, whether they be expatriate companies or whether they be domestic companies in the tropics, who may put in plantations where they're really getting their front end revenue, so that they're in a situation where it can't be a losing proposition. Like in the dipterocarp forests in the Philippines, where they get such a good revenue at the front end from harvesting those trees and processing them, and then they establish plantations later. If the plantations were to fail, they've gotten enough cash flow at the front end that they're not making a bad, quote, business decision. But that wasn't the case at Jari, because we weren't really getting revenue from the trees in the native forests that we established. The reason we were clearing the native forest was to establish plantations, not to get a revenue from the wood that we cut there. In that situation, you need to get more scientific information about the asset that you're growing in the future, because you're in a more risk to lose something if that asset doesn't grow the way you want it to grow.

HKS: You talked about the similarities between Brazil and the United States. Even though the motivation is different, economically, one of the most irrational things we ever did was give land grants to railroads to build railroads where there weren't any people. There wasn't any freight, there was no market, there was nothing.

JCW: That's right.

HKS: It was a front end subsidy to get the railroads there, and it developed markets. I guess there have been economists who've studied it and said the return on the railroads has been large, it's been a worthwhile investment. The tax that's been paid back to the federal government and so forth, for it, that everyone got their money back. But still, it's almost like sending a ship to the moon, you know. You don't get much out of it on the front end.

JCW: The person that did the development can't capture all the economic benefits. I can't remember right now the term for that, but it's a public good, essentially. And so if you're the railroads, who are now reaping some of those profits, or in land

development, you would say, Look, we lost money, we didn't get all the benefits. Now it's our time to reap some of the benefits, that kind of a thing. And certainly the Jari project, I feel, has spun off a lot of benefits to the Brazilian economy that couldn't have been captured by Mr. Ludwig. Essentially he was doing things that, if the government wanted to develop the Amazon, they should have been putting in some of that money in the infrastructure. I continue to say that I think the government didn't put in their fair share on the infrastructure for the population.

HKS: O.K.

JCW: As I perceive the role of government to be in a society.

HKS: This may be a silly analogy, but when Mead built this building we're sitting in, the city probably required them to build sidewalks and do other things, to deal with traffic generation or whatever.

JCW: Yes.

HKS: As a part of the cost of building the building, rather than something that the city might itself have done.

JCW: Governments, whether it be Alabama with Mercedes Benz building something up in north Alabama with tax incentives, that's the justification. Because Mercedes Benz is not going to be able to capture all the benefits that they're providing, the government on the front end says, Well, we're going to give you some incentives from a tax standpoint. We didn't ever have any of those incentives at Jari. In contrast, as I said before, to some of the firms in southern Brazil, where there was an actual program where tax incentives were given to the forestry companies, expatriate companies, plus local companies, to establish plantations, the Aracruzes, the Rigesas, the Champions. So we didn't ever capture this benefit. Now, part of that was because of where we were located geographically in Brazil, that I believe it was because we couldn't take advantage of those, and only later did they develop some of the ability to capture some of those incentives up in northern Brazil. Of course, by that time, that whole program was being phased out by the Brazilian government, in terms of doing incentives.

HKS: I've pretty well covered what I had. Thank you for a good interview.