DR. AL WOODCOCK ORAL HISTORY

AW: ... some of the old-timers there at Woods Hole. I don't know whether you knew Mary Sears or not.

FT: No. She just passed away a year and a half ago.

AW: Oh, she did? She lived in Woods Hole.

FT: Let me get us started, and I've got some other lists for you to look at of people. Well, good morning. We're here in Kinuea, in Hawaii, to spend a bit of time with Dr. Woodcock, and go back over some of his amazing career. I'm looking out his window, and he has a lovely view of the mountains, with the clouds hanging over them, and so on, and it's really beautiful. Dr. Woodcock, could you tell us when and where you were born?

AW: I was born in Georgia, in Atlanta, Georgia, on September the 7th, 1905.

FT: Do you remember how many years you lived in Atlanta?

AW: I was living in Atlanta for approximately six years, at which time my family moved to Florida, and that's where I went with them.

FT: Now, I just passed through Atlanta on my way to Oahu, and it's a big, bustling, thriving, very sophisticated city. What was it like back then?

AW: It was very different, I assure you. We lived in the boundary of the city, in the country. In fact, I enjoyed the fact that our house was so far from Peachtree Street and Five Points, that we were just a few minutes walk in open fields and farmland and forestland.

FT: How about your parents? Could you tell me their names and what they did?

AW: They were both born in England. My father was born in Manchester, and when he was eight years old, he was put to work in the mills, and when he was 12 years old, he was running four looms in a mill in Massachusetts. In the meantime, the family had moved to America.

FT: He wasn't with American Woolen, by any chance, was he?

AW: No.

FT: Because I had an uncle that did mill work for American Woolen in Plymouth.

AW: Later on, he worked for the Continental Gin Company. They manufactured cotton gin machinery, and he was an expert machinist. In fact, I worked summer times running one of the machines in the Continental Gin Company in Atlanta.

FT: How about brothers and sisters?

AW: I had one sister, Florence, and two brothers, Harry and Frederick Woodcock. Harry died of pneumonia when he was 12 years old, so there were just the three

surviving children.
FT: Are there any of them that are surviving now?
AW: No, I'm the last specimen. (Laughter)
FT: How about your wife and children? Could you tell me a little bit about them?
AW: My wife was Mary Ellen Hayes. I've forgotten just where I met her, but her father was a professor at Mount Holyoke College for Women in Amherst, Massachusetts. I guess it was near Amherst, in a small town called Mount Holyoke. And Mount Holyoke College for Women was the name of the college as well as the town, Mount Holyoke, both in Massachusetts.
FT: How about your children?
AW: I have three children, a son, John, and two daughters, Joan Marie and Nancy Ann. And the family is really scattered all around the world now. (Laughs)
FT: Tell me about John. Where is he living, and what does he do for a living?
AW: John is a ... believe it or not, he's a forester, and of all places in the world, he is a forester in Israel. He married an Israeli girl. In fact, he met her in North Africa when he was working for the Peace Corps, and she was the daughter of an Israeli representative in ... diplomatic representative. And John finally ended up in Israel himself, married to her, and he has a family there. He's still an American citizen, but his family is all growing up Israelis. (Laughs)
FT: Where did he get his interest in forestry? Was this ... did you and he used to talk about science and nature?
AW: I don't know where he got it.
FT: How about Joan Marie? What does she do? Where does she live, and what does she do?
AW: She lives in California now.
FT: What part?
AW: Just across the Bay from San Francisco.
FT: Oakland?
AW: Oakland. Yeah, she lives in Oakland. And she teaches there.
FT: Do you know what she teaches?
AW: Professional writing. (Laughs) In fact, I have one of her flyers here. Isn't it a bright color?
FT: That's interesting. There's a lot of similarities between your background and mine. I have a sister that lives in Oakland.
AW: Oh, you do?
FT: Yeah.
AW: That's her.
FT: Oh, yes. I see. Dr. Woodcock is showing me a sheet talking about what his daughter Joan Marie does in terms of teaching, and she teaches creative writing workshops. And how about your other daughter?
AW: My other daughter has been married and brought up a family. She lived in a small town near Philadelphia. She's now retired. Her two daughters are grown up and have their own families, and Nancy is now living in South Carolina, but not on the coast but back inland, in part of the Blue Ridge Mountains that extend down into South Carolina and northern Georgia.
FT: Tell me a little bit about the schools you went to as a young man.

AW: Schools ... I never did graduate from high school. I had two years in high school.
FT: Did you have any teachers that were inspiring to you, or anything like that?
AW: Well, I was very much interested in nature. For years, I tried to talk my father into returning to the farm. He was ... came from England and homesteaded in Florida, and I thought that was an ideal life, to have a homestead. The homestead was in the little town of Sorrento(?), near Orlando, but I never could (Laughs) persuade him to move back to that. He knew the rigors and the difficulties of life on a farm.
FT: But you just enjoyed the outdoors, and growing things.
AW: And wandering in the woods. I remember one of the things I liked to do in the woods is to find a stream and build a small dam and make a pool for swimming. (Laughs) I made my own swimming pool.
FT: So, education -- formal education -- wasn't a high priority in your family?
AW: No, no, it wasn't. My father had only three years of school, and so far as I know, my mother didn't have any.
FT: Now, just as a young man wandering around -- as a kid, really -- what were the kind of things you used to like to do? Just, you know, today's my day and I can do anything I want, what would be your inclination? What would you try to do?
AW: Well, I used to like to hunt. I used to dream that someday I would be able to kill a rabbit and bring it home so that my mother (Laughs) could cook it for me. And I never did kill a rabbit, but I did kill a squirrel once, and I brought it home. But if you've ever tried to eat squirrel ... my mother cooked the squirrel (Laughs) for me, but it was absolutely inedible. It was so tough, I couldn't eat it. I never did kill a rabbit. So my experience in hunting, and my mother's willingness to cook anything that I brought home (Laughs), was a great disappointment to me. And that all happened in the outskirts of Atlanta. In those days, just a few minutes walk, and you were in open country or forestland.
FT: You did spend a couple of years at ... I think they used to call it the Mass Agricultural College, which is now UMass/Amherst.
AW: Yes, yes.
FT: What was Amherst like back then?
AW: Well, Amherst was ... there was the town of Amherst, and then there was Amherst College, which was a man's school, and the University of Massachusetts, which at that time was called Massachusetts Agricultural College. And I was interested in agriculture, and my goal was to have a farm of my own someday. And so I took the Massachusetts Agricultural College course in applied agriculture. And they had what they called placement training, and I was ... part of my training to become a farmer involved six months spent working on a farm. So that's how I happened to meet Fred Middleton.
FT: Oh, that's how you met him.
AW: Who had a 200-acre farm near Hudson. So in working for him, I learned a lot about agriculture, and also I learned quite a lot about the ocean, because he made a very good living farming and he could afford to have a yacht. And he had a 35-foot yawl, and when all the spraying was done for the summer, we used to go cruising, he and I and a number of other people, on the coast of Massachusetts in his yacht. And that's how I happened to ... we stopped in Woods Hole one time, and that's how I happened to get the job at Woods Hole working in oceanography, because I learned about the formation of the Woods Hole Oceanographic Institution just by happenstance.

I happened to get a haircut in a barbershop over one of the stores there in Woods Hole. And the barber was busy at the time, so I sat down to wait, and a man came to sit down beside me, and it turned out that he worked for the Bureau of Fisheries. And I asked him what the building was across the street, and they were just putting up the Oceanography building, and he told me that it was going to be the Oceanography building. And he knew Dr. Bigelow and also Columbus Iselin, and it was from him that I got their names and that I could find them at the MCZ at Harvard. So later I visited Dr. Bigelow, and he turned me over to Columbus Iselin, and I talked to Columbus. And at that time, they were trying to organize a crew to go to Copenhagen to bring the research vessel back. The *Atlantis* was being built in Copenhagen, Denmark, at that time. So I was on the maiden voyage in the initial crew of the research vessel *Atlantis*.
FT: This is all really important material. Let me step back just a little bit. When you first landed at Woods Hole and you were going up for this haircut, what was the village like then?
AW: All I can remember is that the MBL was there -- one building -- and the Bureau of Fisheries. They were the main buildings on Main Street, other than the barbershop and the drug store and the post office. (Laughter)
FT: So there really wasn't very much there then.
AW: No, no.
FT: I mean, now there are restaurants, and t-shirt shops, and all that sort of thing.
AW: There was one restaurant ... well, I guess you wouldn't call it a restaurant. Kind of a sandwich shop (Laughs), at that time, across the street from the drug store, which was brand new. It had just been moved in. (Laughter)
FT: You know, when you heard about this new institution being built, did you have kind of a feeling about, like, wow, I'd really like to work in a place like this? I mean, was it something that just really sparked your imagination, that you wanted to apply for a job?
AW: No. My interest primarily was in the thought that I might be able to get a job for the trans-Atlantic trip, because it involved my way being paid from Boston to England, and then on to Denmark and to Copenhagen. And no one of my family had ever gone back to England, and I was interested in visiting, on the way to Copenhagen, England and seeing some of my relatives in Manchester and my mother's relatives in Kent(?), England. They were both English people. I was the first born of the family in the U.S. (Laughs)
FT: So essentially, your motivation, then, was you wanted to see family in the old country, plus this was going to be a great adventure.
AW: Right, yeah. But I was accustomed to adventures anyway. I was naturally adventurous. (Laughs) I mean, I set out ... when I had a good bicycle, I set out to ride 600 miles from Daytona Beach to Asheville, North Carolina, just to visit my brother up there. (Laughs)
FT: What were the roads like then?
AW: Oh, very poor roads. Very poor roads. Dirt roads.
FT: Did you have many flat tires on the trip? (Laughs)
AW: No. Let's not go into that. (Laughs)
FT: It's interesting. You said that you met Dr. Bigelow first, and he turned you over to Columbus Iselin.
AW: Yeah.

FT: What were your impressions when you met them for the first time? What were your impressions of Bigelow and Iselin?
AW: Well, he was clearly a little impatient with me (Laughs). My absence of an academic background bothered him. But when he turned me over to Columbus, Columbus didn't ... this didn't seem to bother Columbus. He was more interested in what I wanted to do and my abilities -- my probable abilities -- to do it. And so he was the one that actually hired me initially.
FT: So it was Columbus Iselin that really gave you your first break, so to speak.
AW: Yes, Columbus Iselin. And he hired me right on the back steps of the MCZ, you know, at Harvard, the Museum of Comparative Zoology.
FT: Now, it's interesting, that first cruise of the *Atlantis* ... here are some of the names of the people that were onboard, the only one that I could find in the literature. But Columbus Iselin, he was 26 years old and he was captain of the vessel. How did he work out as captain of the vessel? I mean, that's pretty young.
AW: Well, he had a ... there was a man named Clowser who was a professional sailor, and Englishman. And he was actually ... Columbus was indicated skipper, but Clowser was doing the navigation for the initial crossing. I don't know. This probably involved insurance or something.
FT: When you left to come to the United States, you ran into some pretty heavy weather right off the bat, didn't you?
AW: Well, after leaving Plymouth, yes. We had some blows, but we expected that.
FT: How were your sea legs?
AW: Very poor. I was very seasick for a while, but I got over it soon and was able to do my job.
FT: Now, what specifically was your job? What was it you were going to be doing on this maiden voyage?
AW: I was to ... aside from helping with ... standing watch of the wheel, I had to ... let's see ... oh, aid with doing the hydrography, putting the Nansen bottles on the line and lowering them over the side, and recording ... reading the reversing thermometers, and straining off the water samples and bottling the water for salinity observations. And I also ended up doing practically all of the salinities by using(?) a titration method, so I was a pretty important part of it. And Columbus ... he hurt himself rather seriously. I don't know whether it was recorded in the letter to (Inaudible), but he had to remain in his cabin for the first part of his trip across. I've forgotten how long it was.
FT: How about some of the others on that list? There was Terrance Keogh, was it?
AW: (Laughs) Oh, he was a friend of Iselin's, something of a clown of a man. He was a ... a delightful series(?) of stories (Laughs), but I'm sorry I can't give you any quotes of Keogh's stories. And Harold Backus.
FT: He came with the ship, right? Backus came with the ship as engineer?
AW: Yes, he did.
FT: He was quite a character, wasn't he?
AW: Oh, yes. (Laughs) He had a wonderful English accent.
FT: Because I know every now and then, someone will refer ... you know, from the old days, refer to the "Backus factor" on the vessel.
AW: And George Clarke was on it. Higgins ... I don't remember Higgins. Lambert Knight -- he was a sailor, along with me.

FT: Were there any real problems on that voyage?
AW: There were a number of Scandinavians and Norwegians. I'm sorry, I can't recall their names.
FT: Yeah, I couldn't find them.
AW: Walter Molwinkle was one. And there were two Swedish brothers. I can't think of their names.
FT: Was it a little different doing a trans-Atlantic sail, other than just around Cape Cod or out of Nahant(?)?
AW: (Laughs) Very different, of course, day after day after day. There was a relatively violent motion, and getting over seasickness, and learning to sleep. My bunk was right up in the bow, and [WHOO!] it would go up, and then the bottom would drop down (Laughs). Heavy rolling and pitching.
FT: Did you wonder to yourself at that point whether I should continue with this, or did you like it?
AW: Well, I didn't like it, but I realized that it was part of life, and either I got accustomed to it or I quit it and went into something else. But I was naturally interested in environmental things, things going on around me, and I very soon began to realize that there was a relationship between what I saw going on in the marine birds, and what I saw going on in plants floating on the sea surface, and the motions ... what was going on in the water and in the air. The plants in the water and the birds in the air both are adapted to certain types of convective overturning of the surface water. And their lives were dominated by these motions. So I very soon discovered that the reason the plants were in lines parallel to the wind was because these lines were the regions at which the water was converging and sinking, and the plants remained at the surface because they were buoyant and they were drawn just beneath the surface. But there they remained. And the same thing applied to the soaring of marine birds. The regions of convergence in the water were parallel with the regions of convergence over these regions in the atmosphere, in the overlying atmosphere in the first few feet, or few tens of feet, so that marine birds tended to collect in lines, as well as with plants.
FT: Those are those Langmuir cells?
AW: Yes. They came ... Langmuir (Inaudible). And he was the first to point out, a-ha! Here's evidence of convective overturning in the air, or in the water, initially.
FT: Now, these would be cells within the big Hadley(?) cells that cause trade winds and prevailing westerlies?
AW: Oh, yes. The immediate motion of the water in response to frictional drag of the air, and in response to the motions in the air itself.
FT: So you would just look at these things and be curious about them. Is that it?
AW: Well, not only that, but I realized that in order to show that I was correct, I began to realize that I had to have samples of this water, and I had to measure the ... make temperature measurements in the air over these lines of convergence. So I began to make measurements and collected measurements. In fact, I was one of the first to show that the surface film of water exposed to air, only about two or three millimeters actually is in contact with the air, and that the temperature of this immediate few-millimeters-thick water is very different than the (Inaudible) water.
FT: On which many scientists now have based all of their work, on that discovery.
AW: Yeah.

FT: Now, when you got back from that first trip on the *Atlantis*, had the institution itself grown any in size? I mean, did you get any kind of welcome when you came back? Was there a lot of interest in the new vessel?
AW: Well, there was interest in the vessel, and I was ... you see, it was Columbus Iselin that hired me, so when I got back, it was Columbus Iselin who gave me employment. So I was his hydrographer. In fact, I began to go to sea for him when he couldn't go to sea.
FT: Yeah, I have some questions on that. After that first trip, you're back in Woods Hole now, did you have a really strong feeling that you would like to follow this up and do this maybe for a career, this kind of work?
AW: Yes, yes, I did. And I felt that I had a contribution to make, that the evidence of this convective overturning in the air and the water was very ... there was very little evidence, and Langmuir was the first one to publish observations of the surface film temperature.
FT: Did you ever meet him personally?
AW: Yeah.
FT: He was a Nobel laureate, wasn't he?
AW: Yeah. In fact, I was invited to visit him in his summer home, and I was very flattered to have been. (Laughs) He was quite a man.
FT: When you became Iselin's hydrographer and you started to go to sea fairly regularly on the *Atlantis*, could you describe a typical day for you, what a typical 24-hour period on the *Atlantis* would be like for you?
AW: Well, it would all depend upon where we were and what the problems were, the time or frequency with which you made observations. As you know, if you make one temperature section with depth, getting the water samples for hydrographic work, if those stations are 20 miles apart, or 50 miles apart, or 150 miles apart makes a lot of difference. Sometimes it was very difficult. The stations were so close together, I wouldn't have much time to get in much sleep. I used to have quite a lot of eye trouble from eyestrain before I realized I needed glasses permanently.
FT: Yeah, I guess Gerry Metcalf told me one time that the most difficult cruises for him were when the stations were really close together, and he couldn't get the work done in between that he needed to get done before he hit the next station.
AW: Yeah.
FT: So that made a very busy time for you.
AW: Yes.
FT: And yet, didn't you always insist on standing watch and things like that?
AW: Well, no, I didn't insist on standing watch. But if I had to be up anyway, I didn't mind taking a turn at the wheel if it helped out.
FT: It seems to me ... well, one of the things most people don't realize is when oceanographers go to sea, how hard they have to work.
AW: Yeah.
FT: It's a real busy time.
AW: Again, it depends on what the problem is and how frequently you have to be up.
FT: How was your relationship with the scientists in the crew? Did they get along well together?
AW: I never had any problems on that score.

FT: How was the food on the ships back in those days?
AW: It was something of a problem. It depended on the cook. (Laughs)
FT: So you didn't always have good food, huh?
AW: Well, it was ... the main thing I remember about the food was the difficulty of access(?). Have you ever been on the *Atlantis*? So you know what it means, eating from a table that's on gimbles. (Laughs) And you adjust your eating to the frequency of the roll. (Laughs)
FT: And if you're having a little trouble with seasickness, it doesn't help to see the tables and everything moving around you.
AW: Yeah, yeah.
FT: How was ... the ship's company was pretty competent back then? Pretty competent bunch of people?
AW: Oh, yes. I never saw any evidence of any people who couldn't sew a stitch in a sail, or ...
FT: Sure.
AW: No, they hired ... the skipper and Columbus knew good sailors when he saw them, and he ... when the *Carnegie* tied up, they hired a number of the sailors who were on the *Carnegie*. I remember one was Walter Molwinkle, and then there were the Olsen brothers. And that's all I can remember off-hand.
FT: You didn't spend all your time at sea. A lot of the time you were in port, too?
AW: Yeah.
FT: What was your day like when you were in port? What kinds of things were you doing?
AW: Well, I was hydrographer, and I did all the salinity measurements. And this was a big job. I did many hundreds of salinity measurements. It's all in the records. These records must be filed somewhere. I've even forgotten the dates. Was this in the 1940s or 1930s?
FT: Late 1930s.
AW: Yeah.
FT: Where were you living during that period?
AW: I was living on shipboard, and eating on shipboard, when it was in port. And when it wasn't in port, I ... let's see. I stayed with a maiden lady who lived on Millfield Street. Miss Dinkum(?) -- was that her name?
FT: Yes.
AW: Miss Dinkum, yeah.
FT: Do you remember what she charged you for rent?
AW: No, but it wasn't very much.
FT: Nowhere near the $800 to $2,000 a week they get from tourists now.
AW: Great grief, no! (Laughs) I haven't even heard about such numbers.
FT: I don't think you could find a home in your old neighborhood for less than $450,000 now.
AW: Wow.
FT: I mean, it's just ...
AW: I sold my house and a big lot for, let's see, it was, I think, $25,000. A big lot, yeah. Ware Cretell(?) was my next-door neighbor. His father was one of the early directors of the MBL.

FT: Were you able to do much socialization during those days?
AW: Oh, I had a girlfriend, yes. I got acquainted with a very nice girl who was a librarian in Falmouth. In fact, later she married Fritz Fuglister.
FT: What was Fritz like?
AW: He was a delight. He was a very nice guy.
FT: He's another one that's similar to yourself. He didn't have the scientific academic background. He was an artist.
AW: Yeah.
FT: But yet, he ended up the big news on the Gulf Stream, if you will. Now, that's ... do you have any ideas or any thoughts as to why people like yourself and Fritz Fuglister could do so well without an academic background?
AW: I think it was because of Columbus Iselin. He allowed it. I mean, he encouraged it.
FT: He must have been a good picker of men. He must have had a good instinct for who was going to do well.
AW: Yeah. I think he did. And Bigelow turned everybody who applied for a job over to Columbus. He was (Laughs) the ultimate.
FT: Did Bigelow take much part in the general day-to-day of the institution?
AW: Not in my experience, no.
FT: Because I know that originally it was not Bigelow they wanted to hire to be the first director. It was Sverdrup from out on the West Coast.
AW: Yeah.
FT: And I guess he turned it down. And I wondered how much ... you know, I don't think Bigelow really wanted the job, as such. So I wondered how much he really did on a day-to-day basis. And it doesn't seem like he did very much.
AW: Well, he was doing his own research, so far as I know. He was publishing papers. He had a home in Massachusetts somewhere near ... where was that? Where is Walden Pond?
FT: Oh, up in Concord.
AW: Near Concord, in Concord. He had a summer home up there somewhere. I remember I visited up there and went canoeing up the Concord River. That was a great ... I enjoyed that very much.
FT: One of my favorite things to do is to kayak the Sudbury River until it joins the Assabet and becomes the Concord.
AW: (Laughs) Really? Oh, wow.
FT: That Sudbury has become, I believe, now a national scenic river. Very beautiful.
AW: Yeah. I've forgotten where I got the canoe. It wasn't my canoe. I guess it was through Bigelow's ... it may have been Bigelow's.
FT: Did you have any close friends at the institution in those original years? You know, a person you used to see more than others?
AW: Let's see. No, I don't think so. I became very interested in Cecilia Bowman. Did you know about Bowman? That was before she became Mrs. Fuglister. (Laughs)
FT: Oh, okay.
AW: She was a librarian in Falmouth for years. Cecilia was very nice.
FT: She's still around.
AW: She is?

FT: Yes.
AW: I was a great cyclist in those days, and I had a Raleigh bicycle. And we used to go cycling together. In fact, I gave her a Raleigh ... a woman's Raleigh bicycle for Christmas once.
FT: That was *the* bicycle to have in those days.
AW: Yeah, it sure was. But Fritz beat me to it. (Laughs) I guess I was sort of too slow. (Laughter)
FT: You know, I'm interested: Originally you signed on to the first *Atlantis* cruise pretty much as a seaman. Then you became a seaman/scientist, and then you became a scientist.
AW: Yeah.
FT: How did all that happen?
AW: Courtesy of Columbus Iselin. I mean, he encouraged it, and he knew people who would take ... when I was encouraged to write about convective motion, and make measurements, I submitted papers for review. And I remember a friend of Columbus's, who was at Yale, Albert Parr -- I don't know whether you've heard of him or not -- he was Norwegian, I think, originally. But he was in charge of and taught oceanography at Yale. Albert Parr. You know who he is?
FT: Yes, I have, now that you ... when you said "Yale," that triggered it in my mind.
AW: Yeah, he was in New Haven. And he was a great help in reviewing my papers and making suggestions that were helpful in revising the papers and making them more acceptable to the powers-that-be.
FT: So that the peer review committees (Overlapping Voices)
AW: Yeah, yeah. I don't know whether you ever looked at my first papers. The nature of them, the writing, some of it was very dreamy stuff. (Laughs) My first paper, in fact, was published in the *Atlantic Monthly*. Remember that? That's a pretty fancy(?) paper ... journal, I mean. It was not scientific journal, really. What would you call it?
FT: A popular journal.
AW: Yeah. *Atlantic Monthly*.
FT: That must have been exciting for you.
AW: You mean having it ... being accepted.
FT: Yeah.
AW: Yeah. I guess I won't go get the ... my first ... I've even forgotten the title of my first paper. Here, "Birds at Sea," *Atlantic Monthly*, 1938. (Laughs) May 1938. "Observations on Herring Gull Soaring." That was reprinted from the *Auk* -- A-U-K. Is there are journal named ... there is a journal named *Auk*, isn't there?
FT: Mm-hm.
AW: And here's "Convection and Soaring over the Open Sea." Oh, that's my first diagram. I plotted the performance characteristics of different birds against the air-water temperature difference and wind speed, and I got definite patterns of distribution, which told us a lot about the mechanics of the process.
FT: That brings up an interesting point. You just showed me a graph, and I know you were really observant. You know, maybe back ... today what we might call a "naturalist," at that point.
AW: Yeah.
FT: How did you go about learning the hard tools of science -- you know, the

hypothesizing, the testing, the map(?), doing graphs. How did all that come about?
AW: Well, it became necessary if I was going to explain what I saw going on in terms of the mechanics of the process of formation of these motions of the fluids. I mean, the air and the sea under it are in continuous inter-frictional relationships. The motion of the air with respect to the water, and the rising of the air due to the fact that the water is usually warmer than the air, and it sets up what is called convected motions. And the same process is going on in reverse in the water. And of course, this is the environment in which ... in fact, this is the environment in which life started in the sea. We all started in this boundary layer with the sea, as I understand the process.
FT: Now, were there any scientists that gave you help with, you know, how I do a graph, how I ...
AW: Well, yes. Columbus Iselin was one, but Albert Parr, who was at Yale, was more fundamental in that he actually used to make cruises. In fact, he financed the cruises of the *Atlantis* to southern waters, and I made a number of these cruises, paid for by Yale University. I don't know whether you realize that or not.
FT: Did you look forward to going to sea?
AW: Yes, yes.

SIDE 2
AW: ... These papers are almost Math 3(?), if you want to call it that. (Laughs)
FT: So you essentially had to sit down and learn these hard tools of science yourself, how you were going to go about testing things, and forming your hypotheses, and things like that. You pretty much had to learn those by yourself, with a little help from some others.
AW: Yeah. But, you see, you can say, well, you say the water's converging and sinking. How do you know it's converging and sinking? I observed it converging and sinking. And I showed that its convergent nature and the sinking, resulting sinking, was actually due to instability in the boundary layer. And I could prove that by showing that the water that was sinking was colder, and it sank because it was heavier. And that the reason the sargassum formed in the lines was because there, the plant had learned -- learned? Can a plant learn? But all the plants that didn't behave in a certain way, or didn't respond to the physical setting in a certain way -- in other words, they had to have enough air in the floats(?) to give them a buoyancy which would create upward motion that equaled the rate at which the water was going down. If it didn't, the plant would be carried down to the point at which the floats would be compressed and it would fall out to the bottom. So there's a highly selective process going on. All the plants that don't behave themselves, all the plants that don't grow in a certain way and develop a certain buoyancy, were eliminated. So only those plants with a buoyancy sufficient to more than equal the rate at which the water is sinking survived. So there's a (Inaudible) process of selective survival going on in the sea surface, right in these boundary layers.
FT: These were all things you were studying during those first years. When you were first at the institution, it was pretty much a summertime operation. They used to call it a summer camp for scientists.
AW: Not for me!
FT: Yeah, there were three of you that wintered over: yourself, Dayton Carritt, and Dean Bumpus.

AW: What about Columbus Iselin?
FT: Okay. Well, tell me about it. What was winter duty like? What did you do during the winter?
AW: I was very busy during the winter, doing all the titrations. I was determining the salinities from which you determined the density of the water. You needed a temperature and a salinity in order to get the density of the water and to show that a convective process is accounting for what was going on in the sea surface and the resulting water motions, and what these water motions meant in terms of the life within the boundary layer.
FT: Now, did you work at all with Dean Bumpus or Dayton Carritt during the winter time?
AW: They were late comers. I started with crossing of the *Atlantis* (Overlapping Voices)
FT: You'd already been there seven years by the time Dean Bumpus came.
AW: Yeah.
FT: Did you know him well at all?
AW: Well, no, I didn't. I liked him very much. He was a very contagious guy.
FT: Oh, he still is. He's one of my favorite people.
AW: (Laughs)
FT: He's still just full of pep. And because he lives in Woods Hole, every time there's something ...
AW: Is he still alive?
FT: Oh, yeah, he's still going. He drives, and he's got a cane to help him get himself around.
AW: He can still drive.
FT: Yeah.
AW: Several years ago, they made me stop driving. But it was justifiable. I passed out at the wheel once and rammed into the car ahead of me. Luckily, no one was hurt, but that was a complete surprise. The first time I ever fainted was very embarrassing. (Laughs) (Inaudible)
FT: During the winter at Woods Hole, was there any kind of social life going on?
AW: Well, there was for me. I had a lady friend, and we used to do things together. As I told you, she later became Mrs. Fuglister, and she had children, she and Fritz have children.
FT: Well, I wondered what it was like down in Woods Hole during the winter time because as a young man growing up, the Cape used to really shut down during the wintertime.
AW: But winter was the time you went to sea. In fact, cruises were planned so that you spent the winter at sea in southern ports of the U.S. or down in the West Indies. I went all the way down to the Canal zone. In fact, on one trip I went through the Canal, and made some small trips into the Pacific.
FT: Did you have any favorite ports down that way?
AW: Well, I liked Guantanomo, in Cuba, the Navy base. And I especially was fond of studying the soaring flight -- the comparative soaring flight -- of a bunch of birds there. I used to see frigate birds, buzzards -- what were some of the other kinds of birds? Four of five different birds, all soaring in the same thermal. It was very interesting to see

them. And in the morning, none of the birds were in the air. They were all sitting around waiting for the thermals to develop. And it was usually 9 or 9:30 in the morning before you saw any birds in the air, any of the sea-soaring birds. But pretty soon, you would see a buzzard or so begin to soar. And after a while, they were all soaring, the man-of-war birds and the frigate birds and the buzzards, and there were several other birds. I can't even remember the names of them.
FT: You really loved nature, didn't you?
AW: Well, I was a nature boy, yes. It paid off, after all.
FT: It's wonderful when you can make something you live into a full-time career.
AW: Yeah.
FT: You were one of the first people to think of oceanography as an inter-disciplinary science. You couldn't just take chemistry into consideration; you had to take physics into consideration, you had to take biology into consideration, you had to take meteorology into consideration. When did you first start saying, "You can't study the oceans and the air above it in just one science. You've got to have a whole bunch of them."
AW: Well, that same (Inaudible). In order to explain the behavior of all these organisms in the air, it meant that the air was doing these things. One couldn't explain the behavior of these soaring birds without assuming that they had discovered that, in certain parts of the atmosphere, there were places where, if they wanted easy soaring ... in fact, in the early morning, you'd see birds just sitting on the buildings around Guantanomo waiting for the atmosphere to heat up. And pretty soon, a buzzard would take off with flapping flight, and pretty soon, a buzzard began to soar. And after a while, some of the frigate birds and some of the other birds would join in. And after a while (Inaudible) milling around ... I have a definite impression that birds could initiate thermals by vigorous flapping of their wings. And after a while, a whole bunch of birds -- a great milling vortex, as it were -- would take off and go up several thousand feet. And after a while ... they had to stay with the ship, you see. They would take off from the top of a thermal and glide along parallel, slowly losing altitude, and come and land on the water near the ship. This was when we were lying to on station. And of course, they were waiting for the cook to dump stuff over the side so they could come and feed on it.
FT: You still speak with such enthusiasm about those ...
AW: Well, I'm very grateful (Laughs) to the birds for teaching me what was going on in the atmosphere. After all, I'm a bird myself. (Laughs) You've heard of woody cocks(?), haven't you?
FT: Oh, yes! Of course! Sure! (Laughs)
AW: A neighbor of mine gave me that. Did I show it to you?
FT: Yes. (Laughs) That's wonderful.
AW: I've forgotten his name. He lived in Woods Hole, right across the street. Ken Cleves(?).
FT: And you kept it all these years.
AW: Well, this was ... he gave it to me when I was leaving, in 1990.
FT: Dr. Woodcock is showing me a carving of a woodcock (Laughs), a wooden carving of a woodcock.
AW: That's some nose! (Laughter) I can't compete with that. (Laughs)

FT: He made this himself, huh?
AW: Yes.
FT: During those first ten years you were at WHOI, were the facilities increasing at that time, and the staff increasing, and all that sort of thing? Was the institution starting to grow noticeably?
AW: Yes. The major change was in the number of people working in the winter time. You see, there was an old story. The summertime ... because of the natural academic period and the fact that the MBL was practically closed in the winter time, there was hardly anything going on there except the main office for correspondence and so forth. And that was true at the Oceanographic, too, for a long while.
FT: Did the science of oceanography become much more sophisticated during those first ten years you were there?
AW: Well, it certainly did, as far as I was concerned. My understanding was progressing as I attempted to write papers and publish them. And these books are in chronological order. (Laughs)
FT: Was that something that was given to you when you left the institution?
AW: These books?
FT: Yeah.
AW: No, no. I paid to have them bound.
FT: Did you enjoy writing, or was it a chore?
AW: It was work. It was work, yeah. But it was part of the job. And my understanding was improved greatly by the undertaking to write about what I thought, and to submit these papers and get the criticism from ... you see, one of the things that doesn't show up in much publication is the realization of the contribution that critics make to published ... I've tried to give credit in my publications to the criticism of people who ... I would write a paper and then just mail it around to friends of mine, and ask them would they please see if this made sense. And it would come back, almost always, with some suggestions for improvement. And I have a number of the people here that were good critics. Well, there was Columbus Iselin, Charlie Wren -- I don't know whether you know him or not -- Mary Sears, Louis Palmer, Duncan Blanchard, Arnold Arons, and Carl Rossby.
FT: What was Mary Sears like?
AW: She was a very direct(?) and I liked her. She was Dr. Bigelow's, for years, his secretary -- not a secretary, but worked with him, for him.
FT: Well, she certainly chronicled an awful lot of stuff. She put all kinds of things together, besides working as a planktonologist. You know, almost an editor of other people's works. She just passed away about a year and a half ago.
AW: She still lived in Woods Hole the last time I saw her. I've forgotten the name of the street down in the woods, up on the way to Falmouth.
FT: How about some of these ... when you were first there, a lot of very famous people started out there. Here are some of the names. Can you reminisce about any of those people at all?
AW: Well, Dr. Bigelow was ... he was the first director at Woods Hole, but he depended almost entirely for the running of things at Woods Hole upon Columbus. Columbus was the one that I usually dealt with.
FT: Was Columbus a pretty warm person?

AW: Yes.
FT: Was Dr. Bigelow a warm person, in your opinion?
AW: Was Columbus a warm person?
FT: Well, you said he was, but how about Dr. Bigelow?
AW: Well, he depended on Columbus. (Laughs) I never really had much occasion to work for or with Dr. Bigelow. But I did with Columbus.
FT: What do you remember about Arnold Arons from that period?
AW: Arnold Arons?
FT: Yeah.
AW: I liked him. I used to visit him in his home in Washington. In fact, I used to go there to travel out to the mountains of eastern Washington. I was interested in the role of salt nuclei in the formation of snowflakes. But that never did pan out. It proved to be very difficult to catch the snowflake, then melt it and then determine the salinity. And I finally gave up on that and, along with Blanchard, developed techniques for catching raindrops on a glass surface that was coated with a film that gave you a nice hemispherical drop when a drop would fall on it. And I had a technique -- or we had a technique -- for taking individual drops, raindrops, and measuring the salinity in the drops, then to show whether or not these salinities matched the weight of the salt particles in the air. I had a technique -- it seems almost like a dream now, it's been so long since I did it -- to collect by impinging ... flying in an aircraft, exposing very small glass slides to the air stream, little glass slides one millimeter wide. And I could put a device out into the air stream from the airplane, expose it for two or three seconds, and draw it on, then put the slide under the microscope and determine the size distribution of the salt particles on the slide.
FT: Was this a technique you developed yourself?
AW: Yes.
FT: You know, it's interesting: Have you ever heard the name Jane Goodall?
AW: Goodall?
FT: Yeah.
AW: No.
FT: She did an interesting experiment a whole bunch of years ago. Dr. Louis Leakey, who's a famous anthropologist, hired a woman who had absolutely zero scientific background whatsoever to go in and work with chimpanzees in Africa and research them. And his idea was that if you sent someone that hadn't had the formal education, that their creativity and the unique ways they would go about researching something and developing techniques would be better than someone who had gone to an academic setting where they said, "This is the way you do it. Don't do it that way, because this is how we do it." And that reminds me of you in many ways, this developing of your own techniques.
AW: Yes, yes.
FT: How did you pick the projects you worked on?
AW: They picked me (Laughs), in the sense that I saw what I thought was going on, and I developed techniques for sampling the air or whatever, and then to test ... to see whether or not the convective motions were actually going on. These salt particles were the same salt particles that I got in the laboratory when we formed bubbles beneath the surface. You remember all the work that was done to show that when a

bubble bursts at the sea surface, a cavity is left, and as the surface water converges on to the center of a bursting bubble, a jet is formed and it shoots droplets up in the air. Do you remember that work?
FT: How did you get interested in that in the first place? You know, sea salt nuclei -- how did you get interested in that?
AW: Well, I had to know what was going on in the air in order to explain the motion of the air.
FT: So one thing led to another, and led to another ...
AW: Yes, that's right.
FT: It wasn't a case, then, where anyone else steered you into that line of research? I mean, you were responsible only to you?
AW: Well, I was helped by people like Blanchard and ... who was one of the others? Blanchard was one of the principle ones. And Ray Montgomery was a great help.
FT: Did you have any scientific heroes back then?
AW: No.
FT: Was there any significant contact between Woods Hole Oceanographic Institution and the MBL, or Fisheries, or any of that? Did they ever work with each other?
AW: No. I'm sure there was, but I didn't know anyone over at the MBL. And the MBL didn't ... the Fisheries had people who went to sea. They had their own boat. In fact, it was the skipper of the Fisheries vessel who told me that Rockefeller had given money for the oceanography building, and also to build a ship in Copenhagen. In fact, it was this information I got in the barber shop in Woods Hole. (Laughs) It was the Fisheries man who steered me to Dr. Bigelow, and he steered me to Columbus, and I first realized that, with my meager sea experience, I could get a job for the maiden voyage of the *Atlantis*, and that was real exciting.
FT: You know, as early as 1935 -- now, that's only five years after you came to the institution -- you in fact became a chief scientist. And that's when Columbus Iselin's wife became ill. This was a winter cruise, that first winter cruise, I believe.
AW: Yeah.
FT: And you had to take over. Were you excited about that chance, to be the big gun?
AW: Yeah. It wasn't easy. I had a lot of trouble before I began to wear glasses, when I needed glasses. And I remember having a lot of eye trouble from having to ... I didn't get adequate sleep, because I had to get up at every station, and the stations were very close together. I would just turn in and get a very few hours sleep, and we were on a station again. (Laughs) MacMurray would send a sailor down to wake me up.
FT: Were you excited about this first chance to be a (Overlapping Voices)?
AW: Oh, yes, I was, because I realized that I was in a position to prove that the things I saw going on were actually going on, that it wasn't my imagination (Laughs) that was involved.
FT: Well, Columbus Iselin must have had a lot of faith in you, because he really pushed you into these things fairly early. I mean, five years from your first contact with the institution, to be, you know, the sole scientist on board and whatnot shows that he had a lot of faith in you, evidently.
AW: Yeah. And that cruise was a difficult one. I went right up to within just a few miles of the tip of Greenland.
FT: What was it like?

AW: It was just luck that the weather was good for the whole ... many days. We went straight up into the Gulf, doing hydrography.
FT: Is it hard to do ... ?
AW: No, this was just putting reversing thermometers on the line. And the reversing thermometers, you had a water bottle, it was called. It was a metal thing with two valves, top and bottom. And from this, you could get a water sample. Then the problem was to titrate to get the salinity, and the with the temperature and salinity, you could get the density, and this gave you the stability of the water. And the variation of the stability depth gave you an idea of the currents.
FT: Now, did you have any idea that, if this cruise did not go well, that might be the end of winter cruises for a while?
AW: No, no, but I realized that Columbus would be delighted if I could do this job for him, and I was pleasing Columbus and also proving myself that I could do that.
FT: Were there any people at WHOI that you really admired, that you really thought were special?
AW: Employed people, you mean? I liked Norris Rakestraw very much. Did you know him?
FT: What was he like?
AW: He was very easy to get along with, and interested in oceanography. He is an oceanographic chemist, you probably know. And who else? Columbus.
FT: Was Al Vine around in those days?
AW: He was later.
FT: Maurice Ewing -- was he around?
AW: These were the early days of the Ewing dynasty. He very shortly had his own ... he moved from Woods Hole to New York, to the University ...
FT: The Lamont Doherty Labs at Columbia University?
AW: Yeah. He was an interesting man.
FT: You met him, personally?
AW: Oh, yeah.
FT: What kind of guy was he?
AW: He was very dynamic, and enjoyed talking oceanography. He was a highly trained man, and much more of a mathematics man than I ever was, so much of his work I couldn't understand and didn't understand. But this didn't ... it bothered me, but it didn't interfere with my own approach to oceanography. I was allowed to continue in my approach to oceanography largely due to Columbus Iselin.
FT: When World War II came along, you and others had to put aside the work you were working on and gear up for something brand new. I mean, biowaves(?), and BTs, and all this kind of thing. How did you gear up for all that?
AW: I expected to be sent over to the landing in Japan. In fact, I was sent down to Florida, between Palm Beach and Miami, to test out some rockets that the Navy had developed for ... they called them smoke rockets. They would, from a boat offshore, shoot the rockets in toward shore, and the rockets would fall along the shore and begin to develop smoke, or haze. And if the water was colder than the air, the smoke would stay down in the surface layers. And the plan was to develop these smoke rockets for the initial landings in Japan. The Navy was getting ... this was before anybody knew anything about the A-bomb. And it was a great relief to me to realize that it wasn't

necessary for me to go over to Japan to take part in a landing. There wouldn't be any landing because of the A-bomb. But anyway, we were testing these smoke rockets in preparation for a landing on Japan.
FT: Did you have to work with new people during that period?
AW: Well, new to me, yeah.
FT: Did that work out okay?
AW: Yeah. And with these ... I was the first to emphasize the importance of information concerning whether or not the lower air was colder than the water or warmer than the water in determining what was going to happen in the air, and whether or not these smoke rockets would produce a screening smoke that would stay down or whether it would just rise above the surface and not do any screening at all. But luckily, the landings never occurred because they weren't necessary. The A-bomb saved all of that. That probably would have been a very bad thing, the invasion forces going right in on the homeland of Japan.
FT: So you had to come up with a whole bunch of new techniques to investigate this smoke and things.
AW: Right, just to demonstrate that you had to know what the air-water temperature differences were in order to explain whether or not you were going to make a screening smoke or no screening smoke, that it would simply go up. And I was able to demonstrate the conditions under which the smoke did go up, and how it formed. In places where air was converging, the smoke would all go up. And that's all published in papers. I used to have some. "Convective Motion in the Air over Sea," and that was the New York Academy Science, with Jeffries Wyman. Did you ever hear of Jeffries Wyman?
FT: Mm-hm.
AW: And I published a paper with Henry Stommel.
FT: What was Henry Stommel like?
AW: He was a delightful guy, full of stories and jokes and whatnot. But he was his own man. (Laughs) And Gordon Reilly at Yale.
FT: You know, some people think that Henry Stommel was the finest oceanographer of the 20th century. Did you see that kind of quality in him?
AW: I didn't know enough about his oceanography to be able to say. Obviously, he was able to pass judgment, as it were, and have judgment passed on him of people who did know enough to be able to judge his work. But I never felt that I could do justice to his work. So I don't know.
FT: During that war period, that Second World War period, was the institution growing in size? Were they putting new buildings up, or new labs, or getting new ships, or anything like that?
AW: I've forgotten whether the new buildings up in the woods(?) there ...
FT: Oh, the Quisset(?) campus?
AW: Yes. What do they call it?
FT: The Quisset campus.
AW: The Quisset campus, yeah. That came later.
FT: It's interesting, because it was the Second World War that brought that first Navy money into the institution.
AW: Yeah.

FT: And Columbus Iselin was able to keep that going after the war was over. And that lasted ... I think the Navy still is about 40 percent of the funding for Woods Hole, still to this day.
AW: But the Navy ... why is the Navy interested? It still has to do with ...
FT: Well, you know, the ocean is their environment. It's good for them to know as much as they possibly can about it.
AW: Oh, I see.
FT: To me, one of Columbus Iselin's great contributions was that he was able to continue that Navy work and to get the institution from war work back into peace-time work again. Do you remember anything about that period, when they went from wartime research back to peace-time research again? How about in your own case? How did you make that switch from studying smoke and all that back to what your interest really was?
AW: It was no problem. I just went along with my published papers. When were the dates on the (Overlapping Voices)?
FT: Oh, like around '45, somewhere around there.
AW: Yes, my first papers were in the 1930s and 1941. My first paper (Inaudible) was in the New York Academy of Science in 1947. And the one with Henry Stommel in the *Journal of Meteorology* in 1947. And Gordon Reilly (Inaudible). "Diurnal(?) Heating of the Surface of the Gulf of Mexico," in the spring of 1942 with H. Stommel. Wave-riding dolphins (Laughs), McBride(?), *Journal of Experimental Meteorology*. I've almost forgotten what that was all about. Hawaii has a Cloud Physics Laboratory.
FT: Now, did you do that when you were still at Woods Hole, or when you moved to Hawaii?
AW: That was 1953. I've forgotten what ... do you know what date I moved from ... ?
FT: Wasn't it around '58 somewhere?
AW: I don't know(?). I was still at Woods Hole in '54, publishing papers with Arnold Arons, and Kentsler(?), and Blanchard, and Marty in '55, '56. "Dimorphism(?) in the Portuguese Man-of-War."
FT: Of course, you also studied Portuguese man-of-war when you were working with ... what was it? Well, they were the cells(?), but when you talked about Portuguese man-of-war being right-handed in one hemisphere and left-handed in the other hemisphere.
AW: Yeah.
FT: Tell me about that. Tell me that story.
AW: I guess the problem(?) is still open, so far as I know. No one has proven conclusively that in the southern hemisphere, all the particles(?) ... all the physalia are left-handed or right-handed. But anyway, the handedness ... are you familiar with the physalia? You have a float here, and you have tentacles below. And one end of the physalia is pointed(?), and that's called the bow end, and the other end is the stern, and the tentacles are attached on the windward(?) side. And so the tentacles ... the wind pushes against the sail and the water drags the tentacles. In this hemisphere, the physalia is right-handed, if you call this the bow end, and in the southern hemisphere, it's just the reverse. The tentacles are on the opposite side.
FT: And what did you attribute that to?
AW: To the fact that, in order for the physalia to be able to feed in the water that has food in it, it has to be able to stay in one part of the ... the wind is blowing over the

surface of the water and it sets up these regions of convergence. Well, the right-handed physalia will sail downwind and parallel with the line of convergence in the region in which the water is rising and is ascending and spreading out the surface. So as it sails along downwind, its tentacles are continuously bathed in water which is upwelling and carrying its food particles. And just the opposite is true for the left-handed physalia, sailing to the right of the wind. It's very difficult to explain that without having a diagram to illustrate it.
FT: Sure, I understand that. You know, it's interesting: You were still working at the Woods Hole Oceanographic Institution when you first started coming to Hawaii. What was it over in Hawaii that you wanted to research?
AW: Well, in the meantime, I was involved in an international physics project. In fact, I was instrumental in initiating it. Project Shower? Did you ever hear of Project Shower? And Blanchard and I, and Ted Spencer at Woods Hole, and some others went all the way out to Hawaii because on this island -- not this island, but on the big island -- the region up the mountain slope behind Hilo was an ideal place for studying the convective motions in the air, and trying to decide whether or not the raindrops that formed there actually formed on salt nuclei. This was in the early days of wondering about the role of bursting bubbles on the sea surface in creating salt nuclei, which would act as raindrop-initiating processes. And so there was really a big-time cloud physics get-together there, with people from Australia and from Germany and Sweden and England, all converged on Hilo and took part in the International Cloud Physics Observatory there.
FT: How long a trip was it to get to Hawaii then?
AW: Well, it was ... the planes weren't ...

SIDE 3
FT: ... still with the Woods Hole Oceanographic Institution. What was Hawaii like then as compared to now? Was it as built up? Was it as touristy?
AW: Well, it was nowhere near the tourist mecca that it is now. I can remember coming in at night, on a flying boat, and the airport on the other side, and bringing my family out here. I think that was in 1931. And I remember my children, when we landed on the ... when we got in a car and drove over to Lanaki, they had rented a house for us in Lanaki, but my children were afraid. The ocean was ... the trades were fresh, and the ocean was roaring, and the night was dark, and they didn't want to ... they couldn't go to sleep, and I had to spend a large part of the night sleeping with them, or trying to reassure them that the ocean was not going to come roaring (Laughs) right in through the house.
FT: It was really kind a paradise then, before all the tourists started.
AW: Oh, yes, this was before the industry started. And you came out ... my first trip out here was in a flying boat, and it was many hours -- I've forgotten how long. And it landed on the water over on the other side.
FT: You know, over the course of your career, you worked with a multitude of problems: sea salt nuclei, advection(?) fogs, laying(?) (Inaudible), breathing(?) volcanoes. To you, what's your most outstanding work? What is the one that you think the most highly of?
AW: That's a difficult question. All I can think of is that I'm very pleased that it turns out that the things that interested me and I thought were most significant really turned

out to be as the years passed by. In other words, the idea that there is a definite relationship between the patterns of motion in the air over the sea, and the patterns of motion of the water in the sea surface.
FT: You were with the Oceanographic Institution for years. What prompted your move? What prompted you to move to Hawaii on a permanent basis and leave the Oceanographic?
AW: I think it was the experience of the international cooperation and the experience of taking part in a study of cloud physics in Hilo that involved a lot of people. There were people from Australia, there were people from Germany, from Sweden, from England, and the U.S., East and West Coast, all converged on Hilo. And I liked the idea of combining the skills, the observational skills, of an international group like that and contributing to it myself, and learning from the people like Sean Twomey, and Pat Squires, and Erik Erikson -- I've forgotten many of the names -- all converged on Hilo to study cloud physics. And it worked out very well.
FT: Then ultimately you decided to come here on a permanent basis.
AW: Yes.
FT: Why did you choose to do that, rather than stay with the Oceanographic?
AW: I can't immediately recall why. It may have something to do with family. My wife and my children enjoyed life in Hilo. We spent a whole year in Lanaki, courtesy of Wendell Morley(?) and the University of Hawaii.
FT: So you just thought it was a good time for a change?
AW: Yes.
FT: Did you keep any Woods Hole contacts after you moved to Hawaii on a permanent basis?
AW: Yes. In fact, I encouraged people to come out here. Blanchard was one of those who came out here, and Ted Spencer, and others.
FT: How big was the department that you moved into here at the University of Hawaii?
AW: It was a very small one.
FT: Has it grown since then?
AW: I don't know.
FT: Did you enjoy the teaching aspect that you had to do?
AW: I didn't do any teaching.
FT: Oh, you didn't do any teaching?
AW: No, all research.
FT: Did you ever regret leaving the Woods Hole Oceanographic and moving?
AW: Well, for a long while, you see, I owned a house there, and I had planned to go back, but ... in fact, it became necessary, if I was going to buy a place here, that I would have to sell the house there.
FT: (Laughs) Like most of us. Everybody's one paycheck away from disaster all the time.
AW: (Laughs) Yeah. The apartment ... I still own the apartment over in Honolulu.
FT: Oh, do you?
AW: Yeah. It cost me originally $22,000, and I spent about $10,000 fixing it up. So it was over $30,000 (Inaudible), and I had to sell the house in Woods Hole.
FT: Well, let me ask you, Dr. Woodcock, is there anything that you thought I might ask you about that I didn't ask you about?

AW: Anything that was left out?
FT: Yeah. Anything you think we should talk about in greater depth, or that I left out, or anything like that?
AW: No, no.
FT: Well, very good. Thank you very much. This has been a terrific experience for me.
AW: (Laughs) Well, a new experience for me. I've never been ... what do you call it?
FT: Oral history?
AW: Yes.
FT: Well, we only put very special people in the oral histories (Laughs), and you're one of them. (CUT) ... We're doing something rather unexpected in that I talked to Dr. Woodcock on the phone, and he said he'd be willing to do some more in the way of answering questions, so we're back out here again. We're going to flesh out some of the things we had talked about before.
AW: And you can make it "Al" instead of Dr. Woodcock. That would help some, I would think. (Laughs)
FT: Okay, that's great. Joe Padalofsky(?) said something really interesting. He said, in his life, working to get his doctorate was everything in his life. And he said once he got it, it didn't really mean very much to him. (Laughs)
AW: And it was an honorary one anyway. I've often wondered if I really worked for it.
FT: Why don't we start out with that? How did the honorary doctorate come about? It was from C.W. Post, wasn't it, in Long Island?
AW: That's where I had to go to get it, but it came from the man in charge of ... in Denver, Colorado, the professor in charge of the meteorology department there. I can't think of his name now.
FT: Did you know beforehand that they were going to do this, that they were going to award you a Ph.D.? Or was it just a shock to you?
AW: Well, yes. I was told where and when. And fortunately, I didn't have to give a lecture. (Laughter)
FT: Were you thrilled?
AW: I was very pleased indeed. My mother was especially pleased.
FT: Oh, she was still living then?
AW: She was still living then.
FT: So she had the joy of knowing that the school drop-out ended up with a doctor's degree. (Laughs)
AW: Yeah. (Laughs)
FT: I think that's wonderful. That's really great. So that must have been a real high point in your life.
AW: Yes, it was.
FT: Going back a little bit, you worked with Fred Middleton.
AW: Yes.
FT: Could you tell me something about him? You know, he's a Harvard-educated man, and it's a little unusual to see a Harvard-educated man that's a farmer.
AW: Yes.
FT: What was he like?
AW: Well, he was interested in agriculture, and after he finished Harvard, he wanted to

learn something about agriculture. So he went out to Amherst and joined the University of Massachusetts Agricultural College there at Amherst and took their two-year course, and then bought a farm. This was a course in practical agriculture. And he ended up with 200 acres of Macintosh apples. I used to drive a truck into Boston hauling Macintosh apples to the Boston market in the summer time when I worked for him.
FT: You know, it's interesting, that's where I go to buy my apples now, is out in that whole Hudson-Stowe area.
AW: Oh, I see.
FT: It's still apple orchard ...
AW: So it's familiar to you.
FT: Oh, I live right there.
AW: In Concord?
FT: No, I live in Framingham.
AW: Framingham.
FT: Yeah, which is just a town over. And Donna(?) lives in Stowe, and that's the next town over, so yeah, we go out there to buy our apples when they come in, too. The farm was in Hudson. What was Hudson like back then?
AW: It was a very small town. In fact, it was just a few residences and a few grocery stores, and that was it.
FT: What did you do on the farm yourself? What was your job?
AW: Well, I was taking a course in practical agricultural at Massachusetts ... what is it?
FT: UMass?
AW: The University of Massachusetts Agricultural College at Amherst. And I had what they called an applied course, a summer, six months' practical training in working on a farm. And Fred Middleton each summer got a student, and I was one of the students in one summer period. So I spent a whole six months' period working on the farm with Fred, from the period in the spring when we did the spraying, to the summer when we picked apples, to the fall when we packed and hauled them into the Boston market.
FT: Seven-day work week?
AW: Yes.
FT: Did you still observe all the natural things?
AW: Well, yes, but there are not any breaking waves there, and no soaring gulls, or frigate birds, or man-of-war birds, or whatnot. (Laughs)
FT: Well, it's just that you have such a love and reverence for nature that I'm sure you must have looked at some of the surrounding things while you were ...
AW: Oh, yes, yes. It was a great experience.
FT: Did you like the farming?
AW: I planned to become a farmer, but I very soon realized that it would be many years before I had money enough to buy any land (Laughs) to have my own farm.
FT: Do you recall what land cost back then, roughly?
AW: No, I don't. But it was just impossible. I wasn't inheriting any money. And Fred Middleton, his father was a wealthy man, and I think when he graduated from Harvard his father gave him $50,000.
FT: That was a lot of money then.
AW: Yeah. So he spent most of it buying 200 acres of land in Hudson. And it had a very nice old New England farmhouse on it, with an outdoor shower-bath, I remember

(Laughs) that very much. It could be pretty cold, on cold spring mornings, to take a cold shower outdoors in back of the house.
FT: (Laughs) When you were at Woods Hole, the Oceanographic Institution, you served years on the *Atlantis*. Did you work on any other ships, other than the *Atlantis*, while you were at Woods Hole?
AW: No.
FT: I just wondered, because I'm always looking for a comparison between, like, the *Atlantis* and the *Bear*, or the *Crawford*, you know the vessels.
AW: No. Of course, I was on the initial cruise.
FT: Right.
AW: I was fortunate enough to know Dr. Bigelow, be introduced to Dr. Bigelow, and he was the one ... I realized that Rockefeller had given money for the construction of the *Atlantis*. And I immediately thought it would be great to get a job on it, and I saw Dr. Bigelow. And he turned me over to Columbus then, so this was in the fall, when I was thinking of returning to Florida. And I saw Columbus and he said, "Come in the spring and we'll make a trip to Copenhagen and bring the vessel back." So I spent the winter with my mother in Florida and then, in the spring, went up to Massachusetts and crossed the Atlantic on a steamer, and eventually to Copenhagen. First I had an interesting experience. I was traveling with the second engineer, and we stopped in London on our way to going to the coast, going to Copenhagen, and I wanted to visit some of my relatives over there. So I left my friend, Onar McClunen, the second engineer, in a hotel in London, and I didn't want to move in on my relatives with a friend and impose upon them. So I went and visited some of my relatives in Kent(?). And later I telephoned London at the hotel, and I got a telephone call from London, and my friend had gotten into a card game and lost all of his money (Laughs), $400, and I had to immediately drop everything and go to London and bail him out. And then, I had just enough money to pay our joint fare to Copenhagen from the London port. It was a sad occasion.
FT: (Laughs)
AW: Onar McClunen. You showed me some pictures.
FT: Yes, he was on that.
AW: He was one of the people there.
FT: Did you keep in touch with those British relatives, or did you just have the one visit and that was it?
AW: I haven't ... no, I haven't ... I saw both of them, those in Kent and those in Manchester. And those in Manchester were all factory people. Manchester is a factory place. And my father was a machinist and worked in the mills. In fact, he was put to work ... I probably told you this. He was put to work in the mills there when he was eight years old. When he was 12, he was running four ... tending four looms in a textile mill in Manchester. Twelve years old.
FT: It's hard to imagine.
AW: He said that couples got married there and had a big family in a hurry and put the kids all to work. This was accepted practice. Imagine that, just living off your kids. (Laughs)
FT: When you went to school, you actually liked some of the courses that taught you hand kinds of things -- drafting and things like that -- didn't you?

AW: Well, I had to do drafting, but that was when I got to Woods Hole, and doing drafting for my own papers, and for Columbus Iselin's papers.
FT: Did you like to work with your hands?
AW: Oh, yes.
FT: So you liked both the actual work, and you liked the mental stimulation of doing research.
AW: That's right, yeah.
FT: Did you ever design any of your own oceanographic equipment or anything like that?
AW: No.
FT: It wasn't necessary?
AW: No. I was always largely interested in making observations -- visual observations -- of the behavior of plants and animals at sea and deducing from their behavior what must be going on in the water in order to explain their behavior.
FT: But didn't you have to design some things for the sea salt nuclei, to catch them and all that?
AW: Well, I had to develop some instruments for sampling atmospheric salt. I had to do a lot of flying in order to sample salt. I had this problem of determining the vertical distribution of salt in the atmosphere over the sea, and particularly whether or not the formation of raindrops in marine air depended upon the fact that the salt nuclei were hydroscopic: that when air containing these salt nuclei is lifted, the humidity goes up, and as the humidity goes up, water continuously condenses on the salt, and latent heat is liberated. So this salt, even in the sub-cloud layer of air, acts to liberate latent heat in the air, and that, of course, makes air more buoyant. And as it goes up faster and faster, because it gets repeatedly buoyant, you finally get to a point at which you have continuous cloud formation.
FT: That's interesting. During World War II, did you spend most of your time during World War II at the institution doing your work, or were you in other locations? It was when you were working on smoke projects and things like that.
AW: Oh, yes.
FT: The reason I ask is because Dean Bumpus told me that he was away most of the time, and he said, "After the war was over, I was finally able to come back and find out what everybody else had been doing during the war."
AW: Oh, I see.
FT: So I wondered if you were still at the institution and did your work there, or whether you were in some other location.
AW: I remember spending a lot of time in Florida. And I was working for Jim Hughes. In fact, I had an ONR contract with Jim. He was studying the behavior of air over the sea, and one of the problems that the Navy had was how to use ... some of their mechanics had developed rockets -- I guess I told you about this -- capable of firing and landing in the water, and then generating smoke to protect landing troops. The story I heard was that it depended upon us to develop these rockets in preparation for the imminent landing on Japan. They were planning to land the troops, and the ships would come in near the shore, fire the rockets, the smoke-producing rockets, in, and these rockets generated a smoke which tended to stay down near the water. And then the troops would go in under the shelter of this smoke to land. This was what ... it never

occurred, you see. But we were preparing for a coastal landing, numerous coastal landings, in Japan. We didn't know anything about the atomic bomb. At the same time, of course, development was going right ahead on that. And the Japanese really gave up when they saw what one or two bombs could do to a population.
FT: You were not involved in Operation Overlord later, where they tested the atomic bombs at Bikini?
AW: No. That was before the landing.
FT: That's right. I know Arnold Arons was there, and I asked him, I said, "What was it like?" And he said (Laughs), "It just grew, and grew, and grew, and grew," when they actually detonated the test bomb. And of course, that's just the warhead for the big bombs now, you know. It's kind of scary. Now, you worked with Jim Hughes. Was he a Woods Hole employee?
AW: No, he was ONR. (Overlapping Voices) down to the Oceanography Desk at ONR.
FT: So he was in the Navy?
AW: He was in the Navy, yes. The Office of Naval Research.
FT: Okay. For lack of a better term, what was his quality? Good scientist?
AW: Well, he wasn't a scientist. He worked with scientists, and he was the one, apparently, who decided ... if you wanted to work for the Navy, you applied for a contract through Jim Hughes. He was the disperser of funds, and so far as I know, he was the one to judge who would be supported and who wouldn't be.
FT: So he was your contact, in other words.
AW: And my support, actually. During my whole wartime career, he supported my research. I was a Jim Hughes man. (Laughs)
FT: For a period of time, wasn't the money just sent to, like, Columbus Iselin and he would portion out the funding?
AW: I don't know how, the mechanics of it. I was paid by the lab. Each year I had to submit a proposal for additional support, and that depended upon what I had been doing and what I had been publishing, and to what extent Hughes could argue that this research was of interest to the Navy.
FT: Do you recall, kind of ballpark figures, how much funding you might get during the course of a year in those days?
AW: I got a good salary, but I can't tell you what it was. It was enough to support me and my family in Woods Hole.
FT: You know, now the place ... the budget's about $86 million a year now.
AW: At WHOI?
FT: Yeah. That supports about 350 projects that are going on all the time. When I tell people that, they kind of gasp. They're a little bit surprised. I say, "But, you know, if you think of priorities, you have to remember, that's $6 million less than the payroll for the New York Yankees baseball team." So you put the correct priorities there. Just out of curiosity, do you remember what your salary was when you started working for the institution?
AW: It was something like $90 a month.
FT: And you could live on that.
AW: Yeah. I wasn't married though, then.
FT: Could you have supported a family on that?

AW: No, I don't think so. Not very well.
FT: I remember Dr. Bigelow saying at one time that most oceanographers are bachelors because they can't afford to get married. (Laughs) There's something in that. There were a whole bunch of new people that came in during the Second World War, weren't there, to work at Woods Hole?
AW: Yes.
FT: Do you recall anything about the level of professionalism for those people? Were they really quality workers?
AW: You mean, people like Arnold Arons and Al Vine?
FT: Yeah.
AW: Yes. Well, I never felt that I ... you see, I'm a high school dropout, and practically all of the people there were college and graduate school people.
FT: Was that ever intimidating to you, or disturbing?
AW: No, it wasn't. But it was shocking to some people. And Dr. Bigelow was dead-set against my being hired, I remember. And Columbus disagreed with him. It's so long ago, I've sort of forgotten how it all happened. (Laughs)
FT: Well, one of the things about Columbus Iselin, one of his great strengths, was not necessarily as a physical oceanographer. One of his great strengths was judge of men. You know, that he was really good at. And how to handle them.
AW: I first met him in Cambridge, actually.
FT: When you were applying?
AW: I met him on the back steps of one of the buildings there, on the campus. And he hired me on the spot to come up and join the group going to Copenhagen to bring the *Atlantis* back. Number One, Jacobsen's Alley(?). That's the place where I stayed, and rode my bicycle every day in Copenhagen to work onboard the ship while it was on the waves(?), when it was being made ready to go to sea.
FT: That must have been fun for you, that first trip.
AW: Yeah. It was scary, though. I wondered if I would ever be able to climb the mast without being too frightened. So I used to go part way up until I began to get pretty panicky (Laughs), and I gradually eased my way up. But then I get up the first spreaders(?), and then, after many trials, I got up to the second spreaders. And there, the ladder ended, but then I had heard these stories about sailors -- a real proper sailor -- can go up the ladder on the mast and walk out on the spreaders and go hand-over-hand down the back-stays. So I learned to do that. (Laughs)
FT: You really self-educated yourself, didn't you?
AW: I self-trained myself, in anticipation of having to do this at sea.
FT: You know, it's interesting, Al, when I was teaching, I used to claim that there were certain kinds of young people that you could lock in a room and slide books in under the door, and they would come out educated at the end.
AW: (Laughs)
FT: They didn't need me, you know? And I suspect you're kind of the same way. When you take an interest, you do the research and you educate yourself.
AW: Mm-hm, yeah. Well, the problem of writing a scientific paper, first you decide what problem you're going to work on, then you decide ...
FT: Okay, tell me, how did you decide on the problem?
AW: The birds, and the fish, and the seaweed decided that. One of my first problems

was, why do the birds soar into the wind ... all soar in a vertical line? And why, under some conditions, do they enter an updraft and then circle within the updraft and drift with the wind? It was obvious that, in some places, the wind was converging and rising in a vertical sheet, and the birds would get in this vertical sheet and go up in a straight line into the wind. But there are other times when the birds would enter an updraft, and the updraft was simply a vertical column, and they'd get in and then they'd soar around and around and drift on downwind. In fact, I used to have to use the ship binoculars to watch the birds come off the top of these funnels, thousands of feet in the air. The birds are utilizing the thermals to follow the ship. They're waiting for somebody, the cook, to dump things over the side to get a (Inaudible) of it. Birds tend to follow small ships, especially fishing vessels.

FT: So you just started to see that, you observed it, and did you try to find out if anyone knew anything about that? You know, rising in the thermals and all that?

AW: When I started writing about it, then I did look into the literature to see what had been done, and what ideas people might have had.

FT: Did you ever have any difficulty selling the institution on the idea ... that the institution is supposed to be oceanographic and you're working on meteorological kinds of things?

AW: No, no.

FT: They never objected to that in any way?

AW: No, no. Columbus was very pleased that I was able to ... he knew Albert Parr at Yale, and a number of my first papers they published at Yale. Parr occasionally would charter the *Atlantis*, so I met him on shipboard and made cruises with him. He couldn't afford to buy a research vessel for the laboratory there at Yale, so he would just effectively charter the *Atlantis* for a cruise off the Gulf Stream. He was especially interested in the Gulf Stream. Albert Parr?

FT: Oh, I know of him.

AW: I don't know what's happened to him.

FT: You know, that must have been quite a thrill for you, when you say you were a school dropout, but yet having your first papers published by Yale.

AW: (Laughs) Yes.

FT: Did you get a kick out of that?

AW: Well, I was pleased that they were published by a number of organizations. Of course, I was especially pleased about ... well, it resulted from the fact that Parr, who was the director of the oceanography laboratory at Yale, used the *Atlantis*. So that way I happened to meet him at sea, and he encouraged me to submit papers to Yale for publication there.

FT: That's one of the things that the early years of oceanography seemed to do. It was a very small field, so everybody kind of met everybody else at one time or another.

AW: Yeah.

FT: And encouraged each other?

AW: Mm-hm. Well, there was Woods Hole, and Miami(?), and ... where in California?

FT: Scripps?

AW: Scripps, and later the University of Washington.

FT: Didn't Texas A&M come in somewhere around that time?

AW: I think so, yeah.

FT: That's really interesting. What directors did you work under at Woods Hole? You worked under Bigelow.
AW: Yes.
FT: And Iselin.
AW: Iselin.
FT: Who else?
AW: That was all.
FT: Not Iceberg Smith?
AW: Oh, yes.
FT: How about Paul Fye? Was he there when you were there?
AW: I didn't ... I worked under Fye, yes, Paul Fye.
FT: What did you think of Paul Fye?
AW: I didn't have any feeling of judging him one way or another. He was always very friendly and helpful to me, and encouraged me in my publication efforts.
FT: Of all the directors you worked for, how would you rate them, in terms of the kind of work you were doing? Who was number one, would you say?
AW: Columbus.
FT: So you really ... you think very highly of Columbus Iselin, don't you?
AW: Yes, yes.
FT: Did a lot of that come about because of, oh, sort of seamen camaraderie, because you made that first trip together? I mean, you really get to know each other when you're on a small vessel.
AW: Yeah. Well, you see, I didn't depend upon him for ideas, and he was among the first to encourage me to publish my own things and submit papers to various publishing outfits, including WHOI and Yale.
FT: Do you remember, when he started to encourage you, how he went about doing it? Do you remember the kinds of things he said to you, or anything like that?
AW: No, I can't.
FT: Just a feeling that there was a lot of encouragement from him.
AW: Yeah. Well, I never had ... there never seemed to be any doubt that I would continue to be paid by the Oceanographic for the research I was doing, so long as I was able to produce papers that were acceptable to the powers that be. And who were the powers that be? They are publishing groups, or people, who encouraged you to submit papers. And then these organizations ... MBL did this, so I did it, too. You submit a paper to the lab, and they mail it out to professional judges. I don't know whether you realize there are some people who really make a living at acting as judges for papers submitted to organizations. And Parr was one of those, his laboratory there at Yale. My first paper actually wasn't a scientific paper, but I had a friend who was a literary man, and I wrote a paper, a nice short paper, about soaring birds at sea. And he thought ... he was delighted with it, and he encouraged me to submit it to the *Atlantic Monthly*.
FT: Yeah, I know that one.
AW: Did you ... my first?
FT: Yeah.
AW: It was hardly a scientific paper, but it was my first effort at producing a paper that would be accepted.

FT: How were you notified that it was accepted?
AW: By mail.
FT: Were you really pleased when you opened it?
AW: Whoopsy-doodle! (Laughs) Yeah.
FT: Who did you let know? Did you let your parents know?
AW: Yes, yes. My girlfriend. (Laughs) My father.
FT: Were they pretty pleased also for you?
AW: They were very pleased, yeah.
FT: When you left Woods Hole and you came to Hawaii ... well, actually, you were coming to Hawaii when you were still at Woods Hole, weren't you?
AW: Yes.
FT: What was your research then? What kinds of things were you doing then, when you were still connected with the Oceanographic Institution but coming here?
AW: I've forgotten where I met him, but Wendell Morley ...

SIDE 4
AW: ... Wendell Morley rented a house for us on Lanaki, and I brought my family out here and put them in schools, the children in school in the town ... where is it? Right over the hill, isn't it? What is the name of that town?
FT: The next town over?
AW: Well, it's near Lanaki. There's a little town ... as you leave Lanaki coming in this direction, there's a small town where the schools were. So my children were all school age, and so I brought them out and put them in a school and spent a whole year living in Hawaii and flying out over the ocean and doing my study of atmospheric salt.
FT: Do you recall about how old your children were then, roughly?
AW: They were in grade school.
FT: They were just little kids, then.
AW: Yeah, six or seven up to ten or twelve, something like that. Yeah.
FT: Now, when you would fly out to do your work, where was the airport located that you would fly from?
AW: It was on the ... where is it? It's on the other side of this hill.
FT: Oh, so it's right here, right near here.
AW: Yes.
FT: And do you recall what kind of plane you used?
AW: I used Morair(?) planes, single-engine planes. My first trip out here, I came on a flying boat and landed in water.
FT: That must have been exciting.
AW: Yeah. (Laughs)
FT: When you were in the single-engine plane and you were doing research, what were you ... why were you in the plane? What was your purpose for that?
AW: Well, I needed to answer the question of what kinds of particles are present in the air that are important in rain formation, and how large the particles were, how they were distributed. Were they generally distributed in the atmosphere in general, or did they steadily decrease in concentration as you went up? That kind of question.
FT: Now, how did you go about researching that? What did you do to find out?
AW: Well, the first thing I had to do was to show that the raindrops actually had salt

particles in them that corresponded to the size of the salt particles that were present in the cloud-free air. And Duncan Blanchard was the man who did most of this work. It involved going to Hilo and going out on the side of the road at different distances downwind. The wind blows on shore at Hilo, and it goes right up the slope. And almost any day, you can follow a shower that's along the side of the road(?). And we had a technique for sampling raindrops from the showers and measuring the salinity of the water in the drops to show that the big raindrops had large amounts of salt in them and the smaller raindrops had smaller amounts of salt in them. In other words, the smallest particles were forming the smaller raindrops, and the big particles were forming the big raindrops. And Blanchard was able to show that that was true. And this was a major contribution to understanding the role of the sea in forming rain.

FT: Now, how did you collect raindrops, individual raindrops?

AW: We'd go out in the rain. First you'd put on some rain gear, and you'd go out in the rain, and we had glass discs about as big as a phonograph record, and these discs were coated with a material called dry film(?). And if you dropped a drop of water on the surface, it pancaked down and then rose up into an almost perfect hemispherical drop. And one of the first things we did was to prove, as I said before, that the big raindrops had the big salt particles. And then the question was, how are these salt particles formed? And we returned to the laboratory to show that they were formed by bursting bubbles. If you introduce bubbles in seawater, and they rise to the surface, when the bubble bursts, there is a spherical cavity. And when that cavity collapses, it collapses in all directions and there's a jet that forms. And when that jet shoots droplets up in the air, they are ... many of them are so small that they remain in the air and are carried up. And we were able to show that bubbling in the sea was essential for the formation of the particles which formed the rain. Actually, if bubbles didn't form in the sea, there wouldn't be any rain over the sea.

FT: What was forming the bubbles in the sea?

AW: Breaking waves. When a wave breaks, it traps air, and that trapped air breaks up into myriads of bubbles. You've seen breaking waves, and they have a blanket of foam.

FT: That's one of the basic ingredients.

AW: Yes. That's a major element in the formation of rain in marine air.

FT: Did any of this lead toward the experiments of cloud seeding and all that kind of thing?

AW: Oh, yes. I didn't do any, but ...

FT: No, but did this form the basis for a lot of that?

AW: Yes.

FT: I wonder what made them pick dry ice and things like that, rather than ...

AW: Well, I don't know.

FT: It would seem that they could seed with salt crystals or something like that.

AW: Yes.

FT: Now, when you came here permanently -- you left the institution at Woods Hole, and you moved here permanently -- what kinds of work were you going to do here in Hawaii, now your home?

AW: (Laughs) It's difficult ... I made so many trips back and forth from Massachusetts out here, and I have to ... you see, my first trips out here were paid for by Wendell

Morley, and this dates way back to 1930, ’31, ’32, ’33.
FT: How long did you stay working actively here in Hawaii? Up till about when?
AW: Before what?
FT: Before you retired.
AW: I’m afraid I can’t answer that.
FT: Was it in the ‘80s, do you recall? It wasn’t in the ‘90s, was it? You were already retired by ’90, ’91, in around there? Ten years ago?
AW: Mm-hm. It’s not coming back.
(Background Conversation)
FT: One of the things you worked on here, though, was the breathing volcanoes -- the air going in and out of volcanoes.
AW: Oh, yes, yes. Well, this resulted from the other work that they were doing on Mona Kea to establish observatories up there, astronomical observatories. And one of the things that the builders needed to know was something about the vertical structure beneath these observatories. And they were doing a lot of drilling in order to explore what they would expect at different depths. And I got their permission to use their drill holes to answer the question of whether or not the mountain breathes. In other words, we know that the atmospheric pressure is changing all the time. Sometimes it’s high, sometimes it’s low. And the question was, when the pressure drops in the atmosphere, does air come out of the mountain? In other words, is a large part of the atmosphere penetrating openings within the mountain as the pressure increases, and does the mountain effectively breathe as the pressure goes up and down? And I was able to demonstrate, using drill holes, that the mountain did breathe. And the breathing corresponded ... the air was coming out ... (CUT)
FT: You were talking about the breathing mountain, and you said you were able to demonstrate that as atmospheric pressure went in the highs and lows, that it actually did breathe.
AW: Yeah.
FT: How did you demonstrate it? I mean, what did you do to prove your hypothesis?
AW: Well, because when the pressure was decreasing, the air was coming out of the hole all the time. And I could put an anemometer into the hole ... I had anemometers that could be used over the holes. This isn’t the one I usually used, but ... you’ve seen these.
FT: Oh, yeah. Okay. And so could you actually demonstrate, the lower the pressure got, the more the mountain breathed ... and the higher the pressure got?
AW: Yeah. (CUT) ... Page 87. “Mountain Breathing,” yeah. There’s a picture of cinder(?) columns on top of the mountain. That’s it. What can we do about it? (Laughs) This is not the place or time to ...
FT: Well, did anyone do anything more with that?
AW: Following this?
FT: Yeah.
AW: Not to my knowledge.
FT: Well, of course, so much of what we find out in science, heavens knows when it’s going to become valuable knowledge, you know?
AW: Yes. Well, that’s the virtue of publishing.
FT: Did you ever go to sea while you were working in Hawaii, or were those days over?

AW: No, I was airborne all the time. No more sea-going.
FT: Now, you were telling me that one of the people we've left out here, your second wife -- that was Harriet Rossby?
AW: Yes.
FT: Tell me about her. How did you two meet?
AW: Well, I met her when she was still married to Carl. Did you know him?
FT: No, I didn't. What was he like? Because he's certainly one of the big names.
AW: He was a great guy, yeah. (Laughs) He was professor of meteorology at the University of Chicago for years, and he summered in Woods Hole. That's how I happened to meet her. And I made some trips out to ... I've forgotten why I went to ... oh, I remember. Well, I met her while she was still married to Carl, but he died after a number of years, and she didn't speak Swedish at all. After he died, which was in Stockholm, she was at a loss over there and didn't know very many people and didn't speak the language. So she returned, and I was instrumental in getting her a job. I had known her when she was Carl's wife in Woods Hole. I was instrumental in getting her a job at running the ... what was the name of that place on the campus at Woods Hole?
FT: The Quisset campus?
AW: No. It's right on the ... facing on the harbor.
FT: Well, let's see. Bigelow, the Bigelow building?
AW: No.
FT: Smith building?
AW: No. This is not in town; this was on the way going toward Falmouth from ...
FT: Oh, up on Quisset campus. The new one. It's about a mile and a half up the road.
AW: Yes. Well, not there, but on the way, there was a ... just after you left Woods Hole and passed the Woods Hole Library, and you go by the ... I've forgotten the names of things. There's a large house ... two or three large houses on the left, facing on the water. And the second one belongs to the ...
FT: Challenger House?
AW: Challenger House. She was in charge of Challenger House for a number of years. And she was my second wife. (Laughs)
FT: When did you start dating, if you don't mind my asking?
AW: Well, after she began a ... she was in charge of Challenger House, and time went by, and I knew the Redfields well. They had a house very close by. And occasionally I would be invited for dinner at the Redfields, and Harriet would be there. And so I began to go with her.
FT: And one thing led to another.
AW: One thing led to another. And she was a delightful woman. I was very fortunate. You've seen that picture?
FT: Yes. What was Dr. Redfield like?
AW: Oh, he was ... I admired him very much. A very genuine man, and he encouraged you to tell him about yourself.
FT: In those days, the institution had a real family feeling, didn't it?
AW: Yes, yes. And I never really understood why Bigelow ... there never seemed to be too much contact between Bigelow and Redfield, or maybe they were two distinctly different periods in the history.
FT: Maybe.

AW: Did Redfield finally become director?
FT: No, he never did. There was Bigelow first, then Columbus Iselin, then Iceberg Smith, and then Paul Fye. And then it started to go up ... John Steele ...
AW: Maybe Redfield in the meantime was getting pretty old, and he probably wouldn't be interested in ...
FT: Well, there is ... one of the big laboratories at Woods Hole is named after him. The Redfield Lab, right on the corner of School Street. Used to be a parking lot, right across from the drug store.
AW: Oh, I see.
FT: Yeah, it's a big, big biological building.
AW: Yeah, it shows up on the photographs.
FT: Yeah. Three stories high, top floor is chemistry, and the lower floors are ...
AW: Yeah, the photographs here. Seeing all this, I was wondering if I lost it. (Laughs)
FT: Well, I just saw the questionnaire on the top, so I just (Inaudible) it up. You mentioned at one point that while you were in Hawaii, you thought you'd eventually go back to Woods Hole again. Was the reason you didn't go back to Woods Hole a financial one, because of the need to have a house here and a house there?
AW: No. I think it was just because my major interests were in the atmosphere out here, and in the mountains. I spent a whole year in Hilo, and making daily trips up to the summit of Mona Kea. I was interested in the lake up there and the details of the structure of the lake, and to what extent the drainage from the lake continued overflowing down the mountain. There was a stream that eventually led right to the saddle(?) area between the two mountains.
FT: Did you ever witness an eruption there?
AW: No. I've seen an eruption on Mauna Loa, but not Mona Kea.
FT: Was there any atmospheric effect from that that was of interest to you?
AW: This was lava from Mauna Loa, but it was Kilowea(?) that finally overflowed and flowed into the sea, and then it got some pretty spectacular steam clouds. And also something ... as a result of flying, I learned something that surprised me very much: that you could see the lava, molten lava, flowing down the mountainside underwater. There would be flashes of light, and apparently there were steam explosions where the water got in contact with the molten lava, and it created enough of an explosion so that you could see the light from the molten lava penetrating out, because the surface lava, which was cool and cold, was blown away by the explosions. So there were flashes of light from these sub-water ... what is the word for sub- ...
FT: Sub-sea?
AW: Sub-surface explosions.
FT: Did you ever think of researching the gases coming out and hitting the atmosphere, and what they were doing?
AW: No. I thought about it, but that would be too much. I had no techniques capable of really using anything. What would I do? I could go down to the surface and see what the particles were in the steam clouds, but I'd already done that with other places where there were steam clouds. But that's an interesting problem: What happens when lava ... we know volcanoes explode in the deep sea, don't we?
FT: Yeah. One of the scientists at Woods Hole now, Debbie(?) Smith, has been researching for a number of years the new underwater ... relatively new underwater

volcano that's building the next of the Hawaiian islands right now.
AW: Oh, yes, yes.
FT: And it's interesting now, National Science Foundation grants are requiring all the scientists, besides doing their research, they've got to have an educational component that goes with it, something school kids can use and things like that. So she set up a big website on the computer where youngsters can look at it and see what's happening with this new volcano in the Hawaiian islands, and it's really interesting.
AW: What is a website?
FT: A website is a thing that you can type in a number on a computer and, boom, you get this thing that will tell you ...
AW: What you want to know.
FT: Yeah. Oh, for example, on my computer at home, I have just about every oceanographic institution in the world on there. I just have to press one button and I can get to Scripps, or I can get to Woods Hole, or I can get to Rosensteel(?) School, or any one of them. It's a wonderful way of (Overlapping Voices) ...
AW: You say you get them; what do you mean by that?
FT: I literally, just like watching TV, I can access their ...
AW: Oh, you mean a photograph of ...
FT: Yeah, but I can access their libraries, I can call up different research papers.
AW: Oh, I see.
FT: I can find out who's on the staff, who's been on the staff, what projects they're working on. It's a wonderful tool.
AW: Magic! (Laughs)
FT: Oh, yeah.
AW: Black magic! (Laughs)
FT: And I'm not particularly good at it. I mean, it's one of these things that now a scientist has to be a really good computer user, at least in the field.
AW: Well, you're very good at interrogating.
FT: (Laughs) Oh, thank you.
AW: You're welcome. (Laughs)
FT: Was the climate at Woods Hole for a scientist like yourself always good?
AW: Was it good?
FT: Yeah.
AW: Why, yes. It never occurred to me to think that it wasn't. But in the mid-winter, when Buzzard's Bay freezes over, the climate (Laughs) ... I know what you mean by the climate. I remember once when it froze over, Columbus Iselin and I hiked over to the Buzzard's Bay shore and walked out on the ice. But when we got there, we couldn't even see the Bay, because west winds blowing on the ice had pushed the ice up into great piles and we had to climb up over these great hunks of ice just to get out on the flat surface. You've never seen Buzzard's Bay freeze over?
FT: No, I haven't. I do remember one time -- oh, maybe 15 years ago -- where off of Falmouth it was frozen out about two miles, and actually a tanker got trapped in the ice out there. It was the only time I've ever seen it like that.
AW: On Buzzard's Bay.
FT: Yeah. Well, leading toward Buzzard's Bay, on that side, yeah. How did you get interested in the advection fogs(?) on the Cape Cod Canal?

AW: Oh, well, I was very concerned with the role of the surface film. You see, the surface film of liquid water can be quite a different temperature than the air. And I've sort of forgotten ... I made some boat trips out on to Cape Cod Bay -- is that the name of it? -- and had a method for measuring the surface temperature of the surface film. And then I was asking myself the question of what happens with water when the bay water was flowing into the canal. But I've even forgotten why I was so interested in it now.

FT: Well, it's difficult not to be. I know many times I will go down and start to cross over the Bourne(?) Bridge, and I'll be in this cloudbank, if you will, and I'll get on the other side and it'll clear up. And then I find there's another area a little bit further down Route 28 where I could be guaranteed, if it's raining one place, it's going to be sleeting there. There's a little area that's a slightly different temperature.

AW: Did you live up in the section above the canal?

FT: No, I live in Framingham. I commute ...

AW: Framingham, oh.

FT: I commute to the institution.

AW: Oh, I see.

FT: My daily commute to get to work and back is 200 miles.

AW: Get yourself a motorboat, the way Columbus did.

FT: I should have Columbus's money. (Laughs)

AW: But that would be a vigorous thing in the winter time, to cross Buzzard's Bay in an open boat. (Laughs)

FT: But that's what all you old original oceanographers were. You were seamen as well as scientists.

AW: (Laughs) I've forgotten what Columbus did when ... I don't think he ... he or (Inaudible) rode on the steamer.

(Background Conversation)

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