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TAPE RECORDED INTERVIEW PROJECT

Interview with Walter Munk
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Interviewer: Lawrence Armi

Armi: Today is September 28, 1994, and we are going to interview Walter Munk. I am Larry Armi, and Gino is going to help us here with the filming and the tapes. I'm going to just assume for the interview that people have available and can read and will have read, ahead of time, your little autobiographical note in your birthday book that was done in 1982 on your 65th birthday. We will assume that we don't have to repeat a lot of that, and we are going to try to maybe talk about things that are mentioned only briefly there in some more depth.

We can start by--it says here that you were born in 1917, we know all that, but what was it like in Austria when you grew up and tell us some more about that...?

Munk: Quite pleasant. I lived for two things--tennis and skiing. I know sooner or later you will be disappointed when you hear how un-intellectual my early youth was. I didn't really think of being particularly interested in anything but skiing and tennis.

Armi: When I grew up, I was mostly interested in body surfing, so I think that's OK. But I guess you went to school, and what sort of things in school...?

Munk: I actually didn't go to school for a while. I was home with a private tutor until I was nine years old. I didn't actually attend school. I remember his names--DeJordan--that is about all I remember about him. He was very distinguished looking, and a little bit disappointed that we didn't work harder. He came every day and we had private lessons.

Armi: Private lessons--

Munk: In everything.

Armi: But you did eventually go to school.

Munk: I did eventually go to a gymnasium, and took up to a certain year, and then when I went to America, alone, without family, I went for one year to a prep school.

Armi: How old were you when you went to America?

Munk: I was trying to reconstruct that because I probably ought to look at the dates in there. But I went to Caltech in 1937, so it must have been 1934; I was 16-17 years old.

Armi: So you went on a ship.

Munk: I went on a ship _____.

Armi: Who met you in the United States?

Munk: You know, I was sent here to become a banker. I think it said so in my interviews. My grandfather had started a bank in Austria, which he owned, and he didn't--that time, banking was kind of interesting. He built the funnicular, for example, in Marrano, in Northern Italy. Judy and I tried to identify which of three funniculars it was a few years ago. They were all three built by Viennese bankers, so it was very difficult to identify. And he built an electric work in Austria, [in] the early times, and he did interesting things. He started a little bank, actually in London, that was named for the man who really did the work. He gave the money and it was called "Cassell and Company," and they eventually started a branch in New York. I was sent to New York to learn the business of the family, and it was considered an enormously good opportunity to be able to work up one's way in a private bank because at one time they used to make a lot of money. That had almost stopped, I think, when I appeared in New York.

Armi: So arrangements had been made in some way for you to be met in New York--

Munk: Oh, yes, I must say, from the beginning, I never went through any hardships of the kind that nearly everybody who immigrates did. I spent my first night in New York on Park Avenue, with the man who owned the bank. And they all picked me up from the ship. I wasn't in dire straits.

Armi: So they must have arranged for the schooling in New York.

Munk: No. Mother did. She learned from the then-American ambassador to Vienna who had been to our house that his son had gone to a school in New York which he thought was so good, and so I was sent to that school. It's in upper New York, on Lake George, called "Silver Bay School," and as it was, you know we'd been in New York this year to meet our family; we went hunting for Silver Bay

School and found it. It closed in the Depression...it's now a YMCA camp on Lake George, near Ticonderoga, and I found the building where I had gone to school, and it was a wonderful place, I thought. So that was arranged ahead of time before I came from Vienna, that I would go to prep school for a year and become Americanized and learn how to be--I spoke English rather well before I came; I was brought up by an English nanny, so I spoke better English probably then than I have ever since.

Armi: Tell me about the English nanny then, do you remember much about her?

Munk: She was very light. She used to weigh 130 pounds and we used to carry her out of the room when she objected to something. That's all I remember...her name was Miss Collins, and she was very angry when we used to carry her out of her room.

Armi: Did you have brothers and sisters?

Munk: I had one brother and one sister. They eventually, after the occupation of Austria, both came to America with my mother. Mother and my stepfather--I must show you a picture of his, who was in the Austrian government. He was head of the Austrian salt mines. If you've been to Austria, you might know that salt mines are a state monopoly and fill a meaningful role in Austrian history. They used to be a private domain of the Hapsburg family, then they became the private domain of the Bishops of Salzburg, and then they became part of the Austrian government. They were a monopoly and he was the so-called General Director, when Hitler came in, and was an associate and friend of Dollfuss. If you remember, Dollfuss as Chancellor was murdered and Schuschnigg was Chancellor when Hitler came in and [he] resigned. So my stepfather and mother then left the country not under terrible difficulties, but before things became bad. They went to England. Mother had gone to school in Cambridge, which was a very unusual for an Austrian girl, the only one, before World War I had been a student in botany when Harold Jeffries was a botanist. You remember his name, don't you? She was under his tutelage when he was in Cambridge. So when we went back to Cambridge on sabbaticals we bought Harold Jeffries in, later on Sir Harold, and he recognized her and called her by her maiden name. It was kind of amazing.

So I grew up in a comfortable way, and none of my family had any particular scientific interests that I knew, none of them had really been working, they all were well enough of, except for my stepfather, but that of course disappeared.

Armi: But at some point, when you were in the United States, you decided you weren't going to be a banker after all.

Munk: I decided that after working in New York in the bank. After I came out of the prep school, I did go to work at Cassell's and my uncle who was a partner decided I should work from the bottom up and I became a runner--take securities and deliver them--I just hated every moment of it, I thought it was a terribly--other people with similar jobs were kind of different from what I was accustomed to and I thought very lonely and unhappy there. So I got myself into International House and took some courses at Columbia at night just to have association with different people and I did that for 2½ years and my mother said that if I gave it a little time and didn't want it, she would let me do whatever I wanted to. So I did work in the bank for 2½ years and then quit and came out to Caltech.

Armi: In here, you also say you sort of talked your way into Caltech.

Munk: I was unusually naive. I thought you choose a school and you go there and you attend classes. Did I tell the story in there?

Armi: No.

Munk: --I bought a car and I drove out to California. I chose Caltech largely because I loved the names of the streets and the city--Pasadena and San Marino and all the streets I thought sounded beautifully romantic and I came out and presented myself to the Dean of Admissions and I said, "I am here and I am going to be in school next year."

He said, "Let me get your papers."

I said, "There aren't any papers. I've never written to you." He was so amazed at my naiveté. He said, "Well, if you take an exam in two weeks or three weeks and pass it, I'll consider it." And I holed up in a little room in California and Lake Street, and I managed to pass my entrance exam.

Armi: Did you have any acquaintances in the Los Angeles area at all?

Munk: I had an aunt in Hollywood who was the widow of the man who had been the partner at the Cassell and Company, at the bank, and she was very sweet to me, but otherwise, no. I was on my own. Not very well prepared.

But I loved California from the very first day I came across the border.

Armi: What made you think you wanted to do Caltech, which was at that time pure science, basically, as in some engineering, quite a bit of engineering?

Munk: I thought it was far enough removed from banking; it would have to do.

Armi: But why not literature, or something like that? What made you decide

that--

Munk: I really don't remember. It certainly wasn't that "I've got to have a scientific career." I knew that I wanted to have a job that gave some opportunity for outdoor work. So I thought in terms of geophysics even then, in a way. But Judy asked me last night, in preparation of your coming, Larry, as to why did I choose Caltech, why did I go to International House..? I don't think I was very thoughtful, I just did things on the spur of the moment; I thought it sounded awfully good. I had seen their catalog and I liked it.

Armi: Driving across the country must have been fun.

Munk: Very exciting.

Armi: Tell me a little bit about that.

Munk: I had lots of time and I thought I would do something which I have never done before or since: that if anything ever came up that looked interesting, or somebody needed help or something, I would stop. So I took forever. I had a little DeSoto, open four-seater, which I bought for $200 or so, and a sleeping bag and that's it.

Armi: So that took you the summer, basically.

Munk: I got there two or three weeks before school started, which was very lucky. That's why I got in. I wouldn't have gotten in if I had been a week later.

Armi: Tell us a little bit about Caltech in those days. That must have been kind of--

Munk: I stayed at Blacker Hall. Mother, when I gave it a chance and quit, like she had promised that she would support me and I got what was at the time a great deal of money: she gave me $10,000. She said, "That's it. You go to school and do whatever you wish." It was a lot of money then. Then I met a beautiful girl named Barbara Sage, I shouldn't mention her; she lived in San Marino and I spent the money in the first year. I learned to enjoy drinking bourbon. I've never really quite gotten over that. I do like bourbon. And we used to meet every evening and have a good time. Then I came back to Mother for more money and she said no. And I had to go to work at Caltech, remained as a student, had to be an assistant and I was actually an assistant in the history department. You know, student assistants don't have to know much, I had to grade and things. From then on, I was really on my own and I managed to squeeze through.

Armi: At what stage--you actually came to Scripps, I guess.

Munk: It was in 1939. I had gone to Caltech for two--I was a junior and I met another girl, who was at Scripps College, whose grandparents had a house in La Jolla. She spent the summer with her grandparents. The man's name, the grandparent's name was J. C. Harper. J. C. Harper was attorney to the Scripps family. There's really no connection between why I went to Scripps, but she spent the summer here and I needed some way to survive here during the summer. So I remember somebody at Caltech said, "Well, maybe you can get a job at Scripps." You know, La Jolla didn't have any businesses then, it only had a few wooden shacks where people summered, but Scripps was one place where people actually worked and got paid. So I came down and interviewed Harald Sverdrup and said, "Can I have a summer job?" And he said, "Yes." And I came in and the library was in what is now the building that's been torn down, across from George Scripps Hall, the building in the _____.

Armi: I brought some props here, some photographs. Maybe we can try to pin them up...[refer to videotape--ed.]

Munk: I lived in what is now occupied by IGPP--entirely an accident, and it was called the Community House, and here it is. There was a little bridge going across and there was through here a few little private doors and some empty bed frames--no mattresses and no sheets and things and I just put my sleeping bag on one of the bed frames. It had a little galley. I don't think I've lived better in my life than that summer. We used to catch abalones very easily and used to eat extremely well.

Armi: I'll bet. What did you do there?

Munk: Harald Sverdrup gave me a desk in the library and said, "You just can read." Harald had just come back from doing an expedition in the Gulf of California and there were some measurements, temperature, salinity, which showed a strange periodicity of something like two weeks--very long, and he said he wondered whether there could be standing internal waves in the Gulf of California, and would I look into that. I had studied--I had become a junior and I had--well, I didn't know anything about the oceans, but I did read some things about internal waves and I did write a paper actually, my first paper, about internal wave things in the Gulf of California. I worked on that. Do I have that in my--? I thought it got published in--oh, yes, there it is. I worked on that and I thought it was really George McEwan--he was there and he was really very discouraging. He almost discouraged me from continuing in that field because he had a sort of a mathematical formalism which made this thing such a dull and uninteresting calculation and I didn't really believe in it, in really getting the phase velocity for a given density profile and so on, and trying to see whether you could possibly have _____. I don't believe, lots of work has been done since, I've never gone back and looked at it again.

But I had a wonderful time in La Jolla. The year after, I decided that was really what I liked to do and I came back to Harald Sverdrup and said I would like to become a PhD student. I was getting my degree...

Armi: Before we come back to Scripps, though, you did get a Master's degree at Caltech with Beno Gutenberg.

Munk: With Gutenberg, although it was entirely on really a Scripps' Master's degree and Gutenberg was kind enough to say that he would be willing to let me continue as a student there for a Master's degree. Then I transferred over to Scripps. So it was really an oceanographic thesis and Gutenberg, who had been my teacher, was really not very much involved. It was really a Scripps affair, even then.

Armi: Now, the reason I asked about Gutenberg was among one of the themes that you talk about as being important is, as you call it, "earth spectroscopy..."

Munk: Roger Revelle used that word and he once gave me a--but I wasn't yet interested in earth spectroscopy, but it was always sort of a tossup whether to go into seismology or into oceanography. I thought they were equally interesting and I didn't think it would matter much if either you would make it in one or you'd make it in the other field. But I enjoyed Scripps better than Pasadena then, even better.

Armi: Pasadena was pretty hot.

Munk: It was hot in the summer, but that wasn't it. I just thought that living by the ocean at that time here at Scripps was pretty wonderful.

Armi: So we get started at Scripps. You mentioned the three rather influential people in your life. They were Sverdrup, Eckhart and Revelle.

Munk: Yes.

Armi: Maybe we can talk a little about their influence on you. There is a very nice picture, which is also in there of Harald and you.

Munk: It must have been either the first or the second year. I'm not quite sure; I think it was probably in the second year, when I came back. After going back to Caltech to get my Master's degree, using Gulf of California work. Then I went to Harald and said I wanted to be an oceanographer; would [he] take me as a PhD student? I think I said in here I was the only student at the time. At that time, there had been previous students like Revelle and Fleming, and Harald Sverdrup--I don't know whether I told about it--I remember asking him and then he sat

silently for a huge long time, like a minute, and he said, "You know, I can't think of a single job that's going to become available in the next ten years in oceanography." In my usual thoughtless way, I said, "Well, I'll take it." And signed up. It was the best thing I've ever done.

Armi: Tell us a little bit about--essentially he was your thesis advisor.

Munk: He was. He became my teacher in all practical cases. He gave me an office in what is now George Scripps Hall. You know, he occupied the office which is now the big room, with a fireplace, on the top floor, facing south. I had the little office in the northeast corner, which is where he had his back door. There was a back door from his office, and he was writing his book, "The Oceans." I wrote about that in "The Sverdrup Years," in the volume that's been published in the Scripps thing--I have it if I can give it to you. And he would come out and use me as a listening sort of thing...I described that he at that time was writing the famous chapter on the currents and water masses of the world's ocean and he had books all over and he would be working on the Indian Ocean, and there were thirty books on that big table, and he'd be walking around and trying in his own mind to find this system, a method to be describing that. We eventually hit upon the method of starting in the Antarctic and going up each of the three basins. And I was his listener, and it was one of the big pleasures of my life; he would go and [say], "How does that sound to you?" and so on, and talk about it; he wouldn't write down one word. Then after a few days of that he would call in Tillie Genter, his secretary, and he would dictate it while he was walking around the room, dictate one piece of a chapter at a time, after he had been talking about it sort of to get his own mind clear as to what he wanted to say.

What he dictated was pretty well what came out. He had this fantastic common sense of trying to take cumbersome, multi-dimensional data of various sorts and work it into some sort of a system. That was his great strength. He was a great synthesizer, trying to take diverse data and put it into one frame of reference.

Armi: Question: This must have been after you--

Munk: That was when I came back in 1940, before I went into the Army. Then, as the year progressed, and there were more and more things happening in Europe, I drove up to Seattle and joined the National Guard. I just felt I had to go and do something. And Harald said, "If you have to go, do it. Come back." Which I did, you see. And then I served in the Army almost two years, a year and three-quarters, and nothing happened. You know, it was called the "Phony War" at the time. Do you remember that? There was no fighting, you see the invasion came--France--came much later. I mean, Czechoslovakia and Poland had been invaded and Austria had been occupied, and I was sitting up there learning when to salute and when not to salute, and getting more and more bored and nothing

was happening, and then Harald wrote me a letter and said that he and Fleming and Revelle started a new group of oceanography in the Navy electronics laboratory, now Naval--it's gone through many different names, the Point Loma Laboratory. There weren't many people around and if I liked to, they would write and get me out of the Army for working on problems of national defense and I was an enlisted man. You see, I joined as a private and never revealed that I had a Master's degree. I didn't feel I wanted to.

So then they wrote and got me discharged...

[At this point, Judy Munk joins the interview.]

J. Munk: I have some old pictures and I--

Munk: Well beyond that. Judy has some pictures where I used to play tennis. I'll bring them in...

J. Munk: She was a tennis girl.

Munk: We played tennis. She sort of got me. One thing Harald accepted me is because Gudrun wanted me as a tennis partner, and then sometimes when she beat me--which is rare--then I get invited for dinner. Fish soufflé [??]
And I got to know them so well.

J. Munk: I have a cute picture of the old days at Scripps, with the boat off the pier...
[More pictures on video--ed].

Armi: ...here's a picture of Walter on the Scripps. That's Roger. It says here, "He's in charge."

Munk: Here's the E.W. That was my first seagoing experience. It was a lovely ship.

Armi: When was this?

Munk: That must have been in the summer of 1939. Does it give any dates? No dates. That's '39. Frank Shepherd was involved, measuring bottom cones...

Armi: So in addition to sitting in the library--

Munk: I did go out on a couple of trips with Roger.

Armi: It was a good summer.

Munk: Yes, excellent. And then I was back and lived there...

Armi: This was taken as a graduate student?

Munk: Then I was a junior at Caltech. They hired me as a summer scientist. The University had a job, "summer scientist." I got $50.00 a month. And lived better than I have ever since.

J. Munk: You could catch all the abalone you wanted to eat--

Munk: [looking at pictures of Fleming, Revelle and Sverdrup]. He [Harald] came to the ship to just see us off. He said he had done his sailing; he didn't really enjoy it anymore...

Armi: We'll now return to these three influential people. We've talked a bit about Sverdrup.

Munk: He was an enormous influence, such a wonderful man; his writing the book was just a great experience.

Armi: When you came back from the Army--

Munk: I worked down at Point Loma, and my first job was a microstructure; we built a fast-responding BT and really got the first measurements of microstructure. You know it used to be considered that when you saw little steps on--the BT's used then were smoked glass slides. Have you ever seen them?

Armi: Oh, yes, I've seen lots of them.

Munk: They occasionally would show a little structure--I think I said in here that it was just it was generally considered the result of _____, of the stylus in the glass slide. So you jammed the thing on the deck and fixed it. And then we built something, which did not have glass slides and got some small-scale structure. I was interested in that in connection with the acoustic transmissions, even then. Some work on acoustic intensities. Then I joined the Army. No, no, that's when I came out of the Army, and then got started on the wave prediction problem, which was really my first major problem, worked with Harald Sverdrup on that in Washington. In the Pentagon. That's a complicated thing. You see, that was a very closely held problem. I got into it because I realized that people were trying to learn to build landing craft: LCDP's. Landing Craft ____ and Personnel...that when the waves exceeded--we trained for the invasion on some Carolina beaches, where there was some sort of amphibious base during World War II. When waves exceeded six feet and the boats would swamp, and people get hurt, they would call off the practice until the waves got down, and then I guess I got the brilliant idea of trying to get some information on what the waves would be like on the landing beaches. And there, during winter, they were

seldom down to six feet. I thought, my God, nobody could be that stupid, you know, we're running into a catastrophe. I mean, even a young stupid person could understand and I said, we've got to do something and persuaded people at a somewhat high level to see what one could do about picking two good days, which is what it would take to get our landing craft ashore. Then I went to Washington and worked on that and Harald Sverdrup joined me and we started from scratch, really, in trying to build a method of wave prediction.

Armi: Now, at that time, the idea of spectroscopy in physical oceanography--

Munk: They didn't understand it at all. Not at all. We all knew even then that our valiant attempt to represent waves by single frequency sinusoids--which we knew wasn't a very good representation, there was something missing, and we didn't know what to do about it. The first people who really--you know, that was unnecessary because in acoustic and electromagnetics people understood continuous spectra very well. But no oceanographers did. You will not find a single paper preceding that period where people considered power spectra--continuous spectra wasn't known. The people who really first did it were the British. That was Sir George Deacon, Longworth Higgins and a wonderful man named Barber from New Zealand, who came to work for the war effort in England, and that's why we first learned about continuous spectra. And the first measurements were made in England by taking wave records, then putting it on a film which was half-black, half-white, with a wavy record in between, and scanning it on a photocell so that when you had a crest, you had more black, and when you had a trough, you had more white. Spinning the wheel, scanning it, and going through a narrow bandpass filter and letting the wheel slow down. As it slowed down, different frequencies became resonant, and you plotted the output against time through a bandpass filter--that was the first spectrogram. And I think the reason why we did so poorly was that it's not easy to build resonance filters at very low frequency. And so you had to have all sorts of devices to transmit wave records into higher frequency light.

It was not until we understood the numerical equivalent of power-spectral analysis, which came with Tookey, that we really began to understand something about continuous spectrum. Then I was among probably the first to use these Tookey methods--we used to form cosine transforms and then do--then do the cosine transform of an article relation, that's how the earlier spectra were taken and I used to go down and use an old IBM 650 at Convair with punch cards, and get our first spectra that way. Then we began to understand how to present--

As far as the wave prediction is concerned, it was a valiant attempt to push that kind of information into single sinusoids, which is always very unsatisfactory. And it's amazing we did as well as we did.

Armi: So how long were you actually in Washington?

Munk: About two years, a year and a half. There were some problems there, which I don't like to talk about. I lost my clearance, as did Harald Sverdrup. Then we--without explanation--I got it back about three months later, also without explanation. It was a very bad time. Judy insisted that I get the papers under the Freedom of Information Act, which I only did last year, and we found the whole write-up, and it's a sorry affair.

J. Munk: We haven't read it yet.

Munk: We read part of it, and Gudrun Sverdrup used to _____; you know she was her own woman, she was Norwegian, and occasionally she used to say things she didn't like about America, and she was reported to the FBI, and then Harald Sverdrup and I, while we were working in Washington on the wave prediction (we didn't know that until we saw these papers), we were shadowed 24 hours a day. I had no idea until we got the papers last year. Morning, noon, and night. It says [that] lights went out in my room at 11:00 pm, and I got up the next morning and I had breakfast there, and finally, they said they [had] nothing they'd found against us, and I got my clearance re-established and I've had it since, in a very satisfactory way.

We don't want to talk about that.

Armi: ...no, let's not worry about that, but I'd like to get into gradually, at least, anyway, into Eckhart. And the way I'd like to introduce Eckhart is that after you published your thesis, you published a very important paper in Physical Oceanography on the wind-driven ocean circulation.

Munk: I went to work in _____ in Norway. That came a little later. When was the year that it was published?

Armi: It was published in April, 1950...

Munk: So that came a bit later. You see, that has a very interesting history that is a little troublesome and because it was proceeded by two papers. The Hank Stommel paper on westward intensification, and the famous Sverdrup paper on open-ocean _____ flow. I put the two together. I think I indeed in fact--Stommel doesn't refer to Sverdrup, and Sverdrup doesn't refer to Stommel. I think the first combination of these two ideas is in fact this paper. And it does give a formula for the transport of the western boundary current, which I don't think is in Stommel's paper, because I think you have to have the whole ocean to integrate the curl across from east to west.

Armi: It also has something else that is kind of interesting that Stommel's paper doesn't have, and that is, it has what I think is a much more closer approximation

to the way the dissipation takes place.

Munk: I did the ?A-Delph-_____; he did the second, didn't he?

Armi: Well, and it's also that yours is a lateral diffusivity and his--

Munk: His is the important paper. I mean, realizing that you don't get western intensification on the F-plane, but you do get it on the beta plane was the great insight.

Armi: Let's talk a little bit about the diffusion problems. That must have been also one of the things that Harald Sverdrup was concerned about; it's actually in his book. He computes the value of the diffusivity to the California current, and there's like an SIO Oceanographic Report #1, which I happened to find actually in Vonoxha's collection of stuff...

Munk: Is this Harald Sverdrup's?

Armi: Yes.

Munk: How wonderful. I had forgotten that.

Armi: Well, it's not even in the Scripps Library, but I ran across it yesterday.

Munk: It's sort of a ?Brundle approach.

Armi: But at least it was some cognizance of the nature of eddy diffusivity, the scales. So that must have been some of the discussion--

Munk: And I don't know; I got 107 or so in that paper or so, didn't I? I forgot where that came from, that number. I mean all it does is to broaden and narrow the westward current.

Armi: I guess the reason I am bringing this in is because you also wrote a paper with Keeling and Revelle on the diffusion in the Bikini Lagoon. That sort of then brings us--at that point, I was still a graduate student sort of looking into this field--to Eckhart. And of course the only knowledge I have of Eckhart as a graduate student was reading the preface to his book.

Munk: That's as far as you got?

Armi: At that point, I got really pretty mad at him.

Munk: Because he used such impossible notation?

Armi: No, because he sort of says--let me tell you what he says about turbulence: "The effects of _____ in turbulence, which modern meteorology and oceanography invoke so freely [that would be like you [WM] and Sverdrup]..."

Munk: He was very critical of that--

Armi: "...to explain many phenomena, but the following pages will contain no account of the effects of turbulence whatsoever..."

Munk: It's too dirty.

Armi: Yes. So--

Munk: You see, Carl was so elegant--

J. Munk: He just went nuts when Walter and Rossby got together--

Munk: He got so angry at Rossby he actually wouldn't talk to him, because Rossby was so un-elegant in his derivations. But you see Carl-Gustav Rossby knew something about what he wanted to get, and if his mathematics getting there was clumsy and maybe even false, it didn't bother him very much. And Carl (Eckhart) wouldn't talk to him.

Armi: What was Carl's effect on you?

Munk: Well, much less so than the other two people. He in a way was discouraging, really. He criticized all these things...he criticized the Del-4th, for example, he didn't think that was a good way of doing it.

J. Munk: You used to go to his classes all the time, and you would come home and be so discouraged and the children would say...

Munk: But they were elegant classes.

J. Munk: [inaudible]

Munk: I took--you know, I think my inference of Carl needs an order of magnitude now; he was a great man, and he wrote some absolutely fantastic papers like the "mixing and stirring" paper, I think is an enormous paper, don't you--?

Armi: It's kind of interesting, though, if you read what Sverdrup wrote back then in this Speculations on Horizontal Diffusion in the Ocean. It also shows quite a bit of insight into _____ of standing too. Even though it's just a short typewritten note.

Munk: But that the stirring and mixing are really _____ process as one producing mean square gradients and the other one reducing it. It's not clearly stated until Carl stated that clearly.

Armi: Yes. I guess the reason I'm bringing this up is that our good friend Hank Stommel of course in his little note about you says that "Carl must have had a terribly astringent effect on Walter."

Munk: That's funny. I had forgotten that Hank said that. You see, I never knew any mathematics in the sense that Carl Eckhart did, you know.

Armi: Do you think it had enough influence, for example, to move you away from the general circulation--?

Munk: It might have. I did a job, by the way, which was entirely inspired by Eckhart, which was Chick Cox's doctor's thesis. Carl edited not the geometry, but the glitter, which is very simple really. I got interested in could we really measure in square slope that way. I started with his notes--it says so in the paper...Then Chick came by one day and said he was looking for a thesis, and did I have any ideas. I said, "Why don't you measure the mean square slope, take photographs of the sun splitter?" And Chick did the work on that.

So that was a Carl Eckhart-inspired thing. And Carl did know an awful lot. The beginning, you know, of understanding stochastic processes in continuous spectra--Carl played a very major role in that. In fact, he has not gotten the credit he has deserved because he didn't publish. He really preceded Wiener in many ways in many of these things.

J. Munk: Did he ever get that book he wrote on the history of science published?

Munk: No...and you know Carl at that time was a very lonely man; his wife was an alcoholic, I was married to Martha then and in a way, he needed us almost as much as he did them. He'd be living alone, cooking his own dinner and things, and it was sort of an honor for me. Then he became director, as you know, for a while, and he got me my assistant professorship.

Armi: But then, if it was kind of an "astringent"--this is what Hank's words--he calls it "astringent"--

Munk: I'd forgotten that.

Armi: I guess Judy is sort of substantiating that, somewhat.

Munk: Yes.

Armi: What happened, then, to sort of change you--?

Munk: After the ocean circulation, I became interested in long-wave problems, basically. Then I really worked on the rotation of the earth, sort of intermingled with long waves, for about ten years. And became totally fascinated with that, and for a while really knew something about that subject. Then became interested in waves, ever longer waves, tsunamis, eventually tides, just because it was so much fun to work with Frank Snodgrass.

[At this point, the microphone to the tape recorder must have become disconnected, because the voices are too faint to hear clearly.]

END OF TAPE 1, SIDE 1

Interview with Walter Munk

TAPE 1, SIDE 2

[The beginning of this tape is blank.]

Munk: ... Carl's influenced, compared to Roger--Carl's influence was human. He was just the most towering personality of how he looked at problems. Harald, also in the way more the human than the scientific influence.

Armi: Let's move on, then to Roger. I have a picture of Roger at Capricorn. Of course, you had a better picture in your--here's Walter--

[Looking at photographs. See videotape.]

Munk: Ben Hudson, Bill Baskin, Arrhenius, Bob Livingston...

Armi: If his influence was more human, give some examples of how that was.

Munk: I thought every time being together with him [Roger Revelle], it was a revelation of independent thinking and so on--it was sort of magic. I worked with him on a few papers, as you will have noticed. That was not the essence of my relation to Roger. We once worked on global sea level and we worked together--we did a few other things, but that was not the essence. I usually took the initiative of these things because Roger would ask for some help, because he didn't know any mathematics at all. And I tried to go and make a model and do it and then we'd work together.

Armi: Sounds just like the opposite to Eckhart...in some ways.

J. Munk: But you were the _____

Munk: I don't think I am.

J. Munk: In fact he used to chide you about being narrow.

Munk: Oh, Roger, terribly, because I didn't know any chemistry and biology and so on--he was very critical of how narrow my--

Armi: Did you feel any need to feel bad about it and go learn some?

Munk: He and I belonged to the Thursday Club, not Thursday, it's named after the man, you know--

J. Munk: Thompson Club.

Munk: Thompson Club. We would meet once a month at the _____ and have ridiculously opulent dinners and talk about things with other people, Crick belonged to it, it wasn't Scripps, it was a La Jolla intellectual group, and it eventually ended up with Crick lecturing on biology because he talks more and so on other subjects. I told Roger one day, "I really don't think I'm really the right person for that because we talk about biology all the time and I don't really know any."

And he said, "Well, I suppose it's too late for you to learn."

And that got me so angry that I had just gotten an invitation to attend a meeting in France on the interaction between physical oceanography and biology that I had declined, that I wired back and said, "I've changed my mind. I'll accept." Judy and I went for a week to France and attended this meeting.

Armi: But Walter, how can that be true? It says here that--it's quite something to look at your thesis; it has a beautiful little printed document here--and then it says here, your "Major Fields" and one of them is marine biology.

Munk: I'd forgotten that...well, he was on my committee and I learned something about diurnal migration from him. Then I did--if I did anything in biology, I worked with what's-his-name on sort of a forerunner of population dynamics with the man who was at Yale--

Armi: Riley.

Munk: Gordon Riley. Those papers, although they're really not any good; I mean, you can judge those. I had some vague idea that there must be some optimum size, because if you're too big, you don't have enough surface to take up any nutrients, if you're too small, you sink too slowly. I realized the diffusion problem shouldn't be handled being stationary because it's of an entirely different magnitude when you sink than when you're stationary. So if you're too small, you sink too slowly, so you don't get any ?mentholation and that kind of intrigued me, and then Riley and I worked together on that. That's what we did. That got more attention than it deserved. It wasn't a very good paper, but nobody else had done anything like that. Nowadays, it's all taken for granted.

Armi: I'd like to move onto one thing that isn't talked about very much in the affairs of the sea, and that's IGPP. You do say in here that "the birth and coming-of-age of IGPP has been one of my most rewarding experiences." Must have been. So let's start off with--I went to some of the documents [laughter] well, let's start off with one. This is addressed to President Clark Kerr, President of the University of California at the time, and it's from Louis Shlichter. It's kind of

interesting and it says:

"It is my understanding that the University made Professor Munk an informal counter-offer"--this is from offers that you had from both Harvard and MIT. The nature of this counter-offer is basically "to provide for the establishment of a unit of Institute of Geophysics at La Jolla," with associated FTE's and this sort of thing.

Munk: 2.29 FTE's? I don't know where that number came from.

Armi: Well, OK. It turns out, in typical university fashion, there's some question about them coming through. We'll avoid that. Was that in fact why you brought IGPP?

Munk: It's odd, it's full of un-systematics. I became unhappy about a project that John Isaac started, because I thought it was too big and too unscholarly.

J. Munk: You realize, Walter, when he married me, my mother asked him what kind of space he needed when we were going to build a house. Walter said he didn't need any space, he didn't believe in big science. All he needed was a bread board.

Munk: ...considering that I got into ?AIDOC, it's a ridiculous thing. But I did go to Roger and said I thought that was really too unscholarly and I would really be in the mood to get a more scholarly group going. I thought it was too diffuse, the thing that Isaac did. And he said, what would you want to do? I said I would like to start a geophysics school because I think that geophysics and oceanography, which are sort of separate, are going to work very well together. That was a proper looking-to the future, because as you know, all of plate tectonics was in the sea, and Roger, in his typical fashion, said, "You don't have to go away to do that. Why don't you do it here? I think it's a good idea, a certain project." It was funny, because Judy, we had our second baby then--

J. Munk: Were about to.

Munk: --and Judy was about to go to the hospital--

Armi: When was that about?

J. Munk: Well, Kendall's 38 now--

Munk: No, not 38.

J. Munk: 37.

Munk: Anyhow, we were ready to go and the phone rang: Harvard, offering me a

chair, and I said, "You know, I can't really talk because I'm about to take my wife to the hospital." Fine, [he would] call us back later.

J. Munk: We were all having a great champagne party in the _____.

Munk: Then we started to walk out, the phone rang again and Judy said, "I bet that's MIT." And it was MIT! It was a fantastic day. I said, "I can't talk, my wife's about to have a baby." And then we had Kendall and our Edie... and then Roger said, "Don't go away. What would you like to do?" And I said that I'd like to start a group within Scripps.

J. Munk: He said, "What can you do somewhere else that you can't do here?"

Munk: That was typical. And he thought it was a good idea to get a geophyiscs nucleus staff.

Does that answer your question?

Armi: Not fully. Let's talk about Harvard and MIT. To what extent--let me ask you, would you have seriously considered going to either Harvard or MIT then?

J. Munk: I would have gone to Harvard for a little while, to architecture school--

Munk: I was very much taken with the man who asked me to come to Harvard, who was the "high-pressure" man who worked with Benjamin...you know, it was great honor to be offered a--I certainly took it seriously. Then Frank Press tried to get me to--not Frank as much as the man that Cecil Green knows so well at MIT. I certainly did consider it, and we really didn't know how we were going to do that. I don't know how close we came to leaving. But Roger really--he thought it was a good idea to have a nucleus of geophysics in oceanography; there was none. I had become interested in connection with rotation of the earth problems. So they gave me a broad education in geophysics, because all geophysical phenomenology eventually comes in and you know, I don't really believe you know a subject until you try and apply it in some other way. I don't learn about it by reading about it. I learn geophysics by seeing what it would do about earth rotation.

Armi: I'd like to get back to IGPP because I view IGPP as one of the most successful institutions around, at least when I grew up.

Munk: It is.

Armi: So the question, I guess, is: You must have had visions of IGPP either here or at Harvard, is that correct?

Munk: No, I would not have started a new group at Harvard or MIT. That was not the problem. I would have just--Roger asked me, "Why are you going?" And I was disappointed in some large-scale ?ATOC like activities at Scripps that followed me. And I had the illusion, maybe, that there would be a more scholarly at Harvard and MIT, an illusion, maybe.

Armi: Let me ask you this--

Munk: It was a discontent with some large projects at Scripps.

Armi: My mother is from an academic background, actually from Germany also, not Austria but Germany, and she calls this someone calls the "Buruffen" effect--it is an effect that physicists have already a name for in German; that means the "calling" effect.

Munk: That's a good word.

Armi: Now, I guess it's 37 years later--were you trying to invoke this in some way and very successfully, of course, and was that necessary?

Munk: Was I using this as a means of getting IGPP started? No! I had no thought that Roger would even, that anybody would even think, no, I did not consider these jobs as a means of getting IGPP started, I did not. I know that it's often done and could have been done, no, I was simply thinking I was disenchanted a little about some of the Scripps projects. I thought I'd like to maybe go somewhere else.

Armi: As a reaction to that--

Munk: Roger said, "What do you want to do?" You know, that's his great strength; the reason UCSD started is he said, [he] always went to people and said, "What do you really want to do?" And people hadn't been asked that, you know. It was very honoring to them. "What do you need to do that?" And then, let's make it possible. That's exactly what he did.

Armi: Let's talk about making it possible. It was very interesting, I thought, that [garbled] about IGPP to the Fleischmann Foundation of Nevada.

[This section is garbled, because of activity interfering with the microphone and an airplane overhead.]

Munk: That _____ little building.

Armi: But it's really _____ half of the funds were _____ construction of the building. And I think that even in this

proposal you say what you just said--you said, "The informal intimacy of the early days at [Scripps, he's referring to] is now gone. We have professional administrators and parking problems. I have found these developments very disturbing, yet have become convinced that a modern scientific institution must have a broader base than that of the Scripps Institution during Sverdrup's days. This suggests an experiment: is it possible to combine the advantages of a small intimate institute with the advantages provided by a modern well-rounded campus? Could one established institute at this campus ?[be] sufficiently small so the director could devote most of his time to teaching and research?" Somewhat the model of Scripps, actually.

Munk: Initially.

Armi: In miniature.

Munk: Yes, in miniature.

Armi: Is that what you really kind of had in mind?

J. Munk: I had worked with _____ I thought was really kind of interesting because it was a space-wise institute. And the way that that worked was that every time somebody told you that you couldn't do something...you said, that wasn't their responsibility. Your--

Munk: I had some independence at Scripps by having Louis Lichter as an additional person.

J. Munk: If you didn't like what Louie did, why then you--

Munk: But I was always 90% tied to Scripps and 10% tied to UCLA...it gave me some independence; it still does. And today--

Armi: Now how did you connect with the Fleischmann Foundation?

Munk: I knew Walter Orr Roberts. I was looking for money to go with the building and this was one of Benchley's seven groups that came through. Eventually--you have the story: the University said they would pay half of it if I could find the other half. The total cost was--I tried to raise $486,000. My number correct?

Armi: That's correct.

Munk: And the accounting of it is very straightforward. I went to Fleischmann eventually. Strangely enough I worked for the Air Force Office of Scientific Research. There was a wonderful man in charge, and they were doing "Vila

Uniform." Does that mean anything to you?

Armi: No.

Munk: The earliest work on how to detect nuclear explosions by underground methods. We did some early work here. And the man who ran that office--it was the old days where the director of something could come and make up his mind--one Sunday morning came down with two Air Force officers and he said, "I like your ideas about what you want to do here. What would you need?" And I said, "$486,000." He said, "I'll give you half of that." And walked out.

J. Munk: This was the same step.

Munk: Same steps--

J. Munk: --they used to be [garbled]

Munk: So then I needed only $243,000. Then eventually I went to--NSF was actually the next. I mean, I tried everybody. The man who was then head of NSF was [Alan] Waterman, the first director. And I'd written him, and he didn't answer. Then I sat on some sort of a White House committee and I saw him in the john, taking a pee, and I said, "Dr. Waterman, I finally got you where you can't run away. What about my request for--?"

And he actually became very perturbed, started shaking, but I got my money. Half of it, he said, if I could find the other half. And then Fleischmann gave us half, it I could find the other half. And eventually there was--you know, there is a geometric theory, half is a quarter is an eighth, which as you know is equal to one, after an infinite number of steps. The final step--actually Bob Knox' father was involved. It was the U.S. Steel Foundation. I'd asked them for $24,000 and _____. It wasn't Bob's father, it was someone else who came down and very politely turned us down in person, came down to San Diego, and said, "I don't see how $24,000 can make a difference; that's why I came down. We don't usually do brick and mortar." Then we told him the story and he thought it was funny and he took the train up to Los Angeles, and he telephoned me from Los Angeles, saying, "It's really incredible but I've changed my mind: we'll give you the money. I really do believe you." A week later, we tied up the whole building project. And of course having Judy interested in building a building which Scripps we thought had never done very well, other than Mr. Gill--Gill's building is John Scripps Hall--Judy said, "We really should be able to do better." [This] started the architectural part of IGPP.

Armi: That is an interesting point, so since Judy is here, I have some pictures, actually, during the construction of IGPP. Maybe you'd like to tell us the basic philosophy of how this--

J. Munk: This is interesting because I'd gone around with Walter looking at various laboratories all over the world. He'd ask about something, and they were always over-designed. And they all were awful, like insurance offices. And they were all terrible. Why would you want to stay there after 5:00, etc., etc. So what we decided was that we would build a building that people might live in, it ought to be livable. We all knew enough about what laboratories they needed, so why did you need an architect to tell you what you should do in the laboratory and Helen _____ had gotten everybody interested in _____, because at the time when we were building houses around here, he thought all the SIA people were pretty ignorant about architecture, and he was trying to infuse some taste. This was a local architect and had done some interesting and very inexpensive projects that had some real romance _____. When he got into lots of money, it kind of evaporated, because he got to be influenced by somebody's jazzy ideas. When he was on his own and had to really perform with nothing, and he had that wonderful design center downtown--

Munk: In San Diego. It used to be wonderful; it's now burned up.

J. Munk: So we tried to get out from underneath the infliction of the architect by the upper campus or any campus or the University...

Munk: Especially their assigning an architect who was an expert in laboratories. We said, "We don't need that. We know enough about labs. We want someone who will help us build a humane building."

Armi: So how did you get out from under them?

Munk: Well, the key is that we had enough sense to tell Fleischmann and the Foundation, "Don't give the money to the University, [put it in] a special account and let me run it." And they did. And having that money in our pocket is the same story as for the Revelle Laboratories--you want some, not much, some money in your pocket--

J. Munk: You said, if they didn't do it the way you wanted--

Munk: I was willing to say forget about it. And something the University can do even less well than building good buildings is to turn down some good money.

J. Munk: Anyway, Lloyd came out and we walked all over that land--

Munk: We chose Lloyd.

J. Munk: --and Deutsche(?) wanted the job at the time--

Munk: He's a famous architect and he was Judy's teacher, actually.

J. Munk: That's another story. But anyway, we took a look at this first idea that Lloyd had and what he did was in his little model, he bridged the canyon. Now, if you remember, Walter lived in the old community--there was a little bridge there at the time.

Munk: That was my first night in La Jolla.

J. Munk: This essentially is the same pattern as IGPP. Right in the exact spot that Walter lived when he was in the basement of this building. As soon as we saw that, as the heart and the laboratory levels opened to the outside, and you at the time (?and Frank?) were thinking about backing up these--

Munk: I think we were the first people in the country to build these portable laboratories. So we wanted the building where you could bring them in and test things, you know, bring them in on shipboard--

Armi: That shows very clearly in the access here.

Munk: You know, Judy had more to do with it than [garbled] _____. She had sketched out various things before we talked to Lloyd.

J. Munk: That was Lloyd's. It repeated itself with ?re-part.

Munk: You had sketched out something and it wasn't what was done, but it started things on a meaningful--

J. Munk: Anyway, Lloyd did this little cardboard model and we started getting a lot of flak from various kinds of people about this...and he sent for Neil Fort--

Munk: Neil Fort was a well-known American architect...

Cecil said, "How can I help you?"

I said, "We need someone to back us up with building something different."

He said, "Why don't you let me ask ?O'Neill to come out? I'll pay his way to consult with you for two days."

O'Neill came out--great time--and he left two days later; he said, "Judy, you've got the right idea--do it." And O'Neill's written statement got us a little bit--you know, we had no credibility whatsoever. Judy never passed her

design/mathematics exam, so either we had no credibility or O'Neill Fort backed up. We think that Cecil--"

J. Munk: Then we were off.

Munk: Then we were off.

J. Munk: Then we were clever enough--Walter was clever enough that we went _____ when they started this building.

Munk: That was after it was all designed.

J. Munk: Yes, but it was interesting because we got letter after letter saying that we had destroyed the campus and it was the worst thing that could have happened. Because you see we--

Munk: Then we were fussing and Judy said, "Let's stop fussing and go away." That was still in the design phase. We went away six months. I strongly recommend that. We didn't do that this time, did we?

J. Munk: We were in a _____.

Armi: So that's the architecture, which is a very important aspect--

Munk: A very important part.

Armi: You can see, it must have been very important, the original architecture of Scripps was clearly very important and influential in that people could live here and feel happy here. And, of course, the architecture is superb of IGPP. But let's talk about the hiring of the initial faculty at IGPP, which clearly you've done a really good job at.

Munk: No, no, there were mistakes, which we probably don't wish to talk about, but let's talk about the positive parts. Gilbert came, Backus came. Backus was the first person. We had a party for him. He officially retired this week. And I said something. We all were there, about 40 people. I said, "You know, George has really done a lot for us; he's such a scholar and so universally respected." He was the first, wasn't he? The first appointment.

Armi: Yes, he was the first.

J. Munk: He was very young, and totally unknown.

Munk: And he didn't know himself either.

Armi: Actually, I think you hired him at the assistant professor level.

Munk: Yes. He came from Chicago.

Armi: No, I think it was the associate professor. He was already assistant--but let's talk a little bit about the philosophy he used. It says here--and this is in the proposal--

Munk: To Fleischmann.

Armi: No, this is actually to the University in some way. But, two things I thought were kind of interesting: Emphasis to be placed on appointments of young men, and large [this is what's going to be funny] project-type research activities are to be avoided.

J. Munk: I'll never let Walter forget that...

Munk: You know today when at dinnertime you're going to stay and we're now having a real crisis with ADOC, you will remember those words--

Armi: And not say them?

Munk: Oh, no, you can say them; I think that will be great fun, because we're running into a problem, which is due to having done something too big. I think ADOC is too big, at Scripps.

Armi: Well, let's talk about that later, about the size of projects and why they're perhaps too big. Maybe think about the other people you hired and why.

Munk: Well, I don't know. That's a very difficult geometry. Different...I don't know. I can't give answers to that. [Garbled] I remember only Klaus Hasselmann. I met him at a meeting, and I can tell you the story--and I thought, here is a terrific man. He wasn't known at all and I offered him a job before there was any committee or anything. I said, "Will you come as assistant professor?" You know, those were times when you could do that. Yes, Klaus appeared at a wave conference and said...he wants to work on a real problem like turbulence--that was Klaus' statement, but he had gotten stuck and he wanted something a little easy, so he worked on wave problems. He got everybody in the room very angry because he solved the wave interaction fourth order problem that nobody had been able to solve, but to him it was a way of having a little vacation from the turbulence problem. That's what he said. And he didn't show off. He didn't realize what a nasty thing to say it was to a group of people who couldn't do the linearize and the action problem.

That was Klaus. I said, "Klaus, come and join us at IGPP." And he said OK. [But] unfortunately his wife became disillusioned with American schools

and went back to Germany. [This is an] easy story about Klaus.

Armi: But then you also asked Freeman Gilbert to join.

Munk: Yes.

Armi: How did that happen?

Munk: I thought he came in with an ideal combination of some Kentuckian robust common sense and knowing his physics. You know, he never has been overwhelmed by physics. I just thought he was a great man. You know, people are good scientists because they're good people. Really, I believe in that. Because they are personalities of some interesting kind. Freeman always sort of intrigued me because he had such an independent country-like outlook on life.

I was left really alone to make those appointments.

Armi: Yes.

Munk: But don't ask me about a few other people we hired at the time.

Armi: Can I ask you about some that you didn't?

Munk: OK.

Armi: Since they're listed on the--the people you might hire--Owen Phipps.

Munk: We cried when he turned us down. He's been very good, isn't [he]? Elegant man. Who else is there?

Armi: Pierre Belander.

Munk: I'd forgotten that.

J. Munk: Oh, I didn't forget that. He was a great one.

Munk: I think he would have done better here than he did in his career.

Armi: And then of course we have the ones I mentioned like George Backus.

Munk: And then, Bob Parker. That was interesting; that came later. That was a ?dirty suggestion. You see, there was Bob Parker and there was McKenzie, Dan McKenzie. You know them both, don't you?

Armi: I know Bob...

Munk: Dan McKenzie's Cambridge. They were the two bright young men at Cambridge in that field. Teddy said, "Dan is better known, but I think you will get more out of Bob." We just asked Bob on the basis of Teddy's judgement, which was excellent.

Armi: Now, let's return to the type of research projects that you actually put down in writing, which I thought was quite revealing. At that time, you were very clear that you didn't watch large research projects, you actually even give the size in square footage that you thought would be appropriate, and that's how you came up this $486,000 as being half of the money you needed, you see.

J. Munk: _____ tells a story ... when you give him a number--

Munk: ...always multiplies by four, he says that, so...Mel Briscoe says whenever I give him a number, he multiplies by four.

Armi: But maybe tell us a little bit about--

Munk: We did one of two things. One of them was to do geology in real time. You know, that really was one of the keys of IGPP--John Burgess working on measuring strain in real time. I thought the time had come when you could measure motions of the earth in real time instead of inferring them from fossil evidence. (Is that what it says here?)

Armi: It talks not really about that, yet.

Munk: Maybe that came up later.

Armi: The fact that you mentioned this has been kind of important. You had a feeling then about the size--actually, I can be specific. You use a counter-example, which is Van Allen. You say that's the kind of work we don't want, when you're talking about planetary sciences, that that required too large –

Munk: Yeah.

Armi: -- a group.

Munk: Yeah.

Armi: And what made you feel that way, that --?

Munk: Well, there was something going on at Scripps, under John Isaacs, whom I dearly love, under his tutelage, which I thought was not -- I think it was too big.

J. Munk: I thought you thought it wasn't disciplined enough.

Munk: And it wasn't disciplined enough, sloppy.

J. Munk: And you thought, when you got too many people involved, [well?] --

Munk: Yeah.

J. Munk: -- the discipline sort of dissolved or --

Munk: Yeah. I should have stuck with that.

Armi: Well, but what --

Munk: Yeah. But, you know, there were several ideas -- I don't know whether they're mentioned. And maybe my memory has changed them a little. But I thought, first of all, we ought to do something in at least two different fields that are related, because it's good for the students, something in the fluid ocean and something in solid Earth.

Armi: Yes.

Munk: The solid Earth idea, which may or may not have come up then, was it seemed to us one should be able to monitor Earth movements in real time, with developing instrumentation, you know, with people talking about the moving continents and things. Could we measure the widening of Baja California? You know, we really thought about this at one time. Could you measure the real vertical motion?

J. Munk: And [just then?] --

Munk: How fast do mountains --

J. Munk: Yeah.

Munk: -- go up and down? And then, of course, John Berger and --

J. Munk: Well, we went and looked for Jim Brune, remember.

Munk: We looked for --

J. Munk: Yeah.

Munk: -- Jim Brune, then, as a person -- Although he was at IGPP, he was not a member of IGPP. You know, we were never very --

J. Munk: He was at Caltech.

Munk: He was at Caltech. We brought him down. But what I meant was he was part of the Geology Department. But, you know, we really defined IGPP in terms of the people who lived there, not necessarily the people who were on our payroll -- who were part of the family. Jim Brune was. We got him here. So the idea of, really, monitoring the movements, the changes in the Earth in real time was a very central idea at some early stage of IGPP. And then came the Pinion Flat. Well, first we built a laser strain meter right here in San Diego. Then we bought Pinion Flat and built the laboratory there. And that, in some ways, you know, helped with the Gilbert -- and things, the normal-mode problem. And we talked about DC seismology -- equals HF geodesy, high-frequency geodesy. And there was an element of that which has carried through at IGPP.

Armi: And you felt that that had to be done at a relatively small scale.

Munk: Yeah, I thought so.

Armi: Yeah. And was.

Munk: Yeah.

Armi: Well, maybe it'd be kind of fun, then, to move on to --

Munk: Yes.

Armi: -- to the next -- to as science got bigger. Now was this your doing, or was it --?

Munk: When did we become big? [Heard?] Island wasn't big. Heard Island was done on a st-- It's only the most recent part, the ATOC.

J. Munk: That's yours, though. That's not general IGPP.

Munk: That's not -- That's my fault -- my doing. Well, I became enamored with the idea of measuring large-scale climatic changes in the ocean by acoustic means. And the instrumentation is expensive, especially the cable-laying. And then it sort of became this marine mammal problem and things, and I think it is a little out of hand.

J. Munk: But it's not out of hand because of the size. It's out of hand because [you spent on something, and that's what you didn't know?]. Because the group that's wanting to -- These are all bunches of small groups --

Munk: Yeah.

J. Munk: -- that wanted to work on this --

Munk: Yeah.

J. Munk: -- as a part of a sort of a necklace.

Munk: Yeah. Well, we may still --

J. Munk: Yeah, and it may still --

Munk: -- put it together --

J. Munk: Yeah.

Munk: -- but it's --

J. Munk: But it's [that?] --

Munk: -- become difficult.

J. Munk: It's gotten mixed up --

Munk: It's cumbersome.

J. Munk: -- in --

Munk: Yeah.

Armi: But maybe --

J. Munk: -- this stupid --

Armi: -- we should talk a little bit about that problem. It's an interesting problem, I think, for physical oceanography. And this interview is being sponsored, to some extent, by the meteorologists, who have --

Munk: Yeah.

Armi: [Now?] --

Munk: And there has been a tendency --

Armi: Yeah.

Munk: -- for big science -- isn't it? --

Armi: Yeah.

Munk: -- since you and I are in -- Yeah. And that is correct.

Armi: And Hank wrote a very interesting little article about this.

Munk: Yeah.

Armi: And it talks about letting the genie out of the bottle, you know.

Munk: Yes.

J. Munk: Right.

Munk: And he would have never got himself in a position of being PI for ATOC, would he? Though he was one of the two people who started [MODE?], he and [Alan?] Robinson. So he did, in some sense, do big oceanography. And he did care about [GEOSEC?], didn't he?

Armi: Yes.

Munk: So he did some large things, actually.

Armi: Well, I guess that brings me back, to some extent, to, you know, when you are a young man at Caltech. And you came down for the summer.

Munk: Yeah.

Armi: If you're now a young man at Caltech, and you come down for the summer, do you think it would have been a similar experience? What --?

Munk: You know, that's an awfully good question, Larry. Could you come down for summer because you had a girlfriend here now and meet people like -- and start a career that way? You know, that's an awfully interesting question. And is it happening now? We should think of people who've done that and how they've -- Probably more difficult, isn't it?

Armi: Probably, yeah.

Munk: And certainly different. You see, I met every member of the Scripps faculty. And most of them were on my committee. You certainly wouldn't have that happen, would you?

J. Munk: I'm just trying to think of some one of your students, [and has?] -- Some of your students, they had some incredible adventures, but I don't know whether that's --

Munk: Like -- Well, you know, we got

J. Munk: Werner.

Munk: -- Werner [Morobetz?] down here. And we got -- Because he knew

someone in San Diego who knew Judy. And he came down and said would I talk to him. You met -- you know Werner.

Armi: I know Werner, yeah.

Munk: And Werner was at Dartmouth, and he came here. And he said, "You know, I want to get a job on a Scripps ship to see whether I want to become an oceanographer." I said, "That's a hell of a way to get evidence to make up your mind. You're never -- Getting a job on a Scripps ship isn't going to tell you whether you want to be an oceanographer. Why don't you just become a student?"

J. Munk: But, you see, that flies in the face of the old Woods Hole business. Because when Columbus Iselin hired oceanographers --

Munk: He hired Fritz [Tupester?] --

J. Munk: That's right.

Munk: -- who was the son of a Swiss cook at the Waldorf --

J. Munk: Yeah.

Munk: -- and was an artist. And Columbus believed that amateurs make the best oceanographers, people -- There was this very imaginative artist, and he would get a better concept of the Gulf Stream than somebody who was doing little sums.

Armi: Well, I guess --

Munk: And may be right!

(break in tape)

Armi: -- the model that he had, I guess. I mean, it --

Munk: Well, no artists applied, of course.

Armi: No. Well -- (laughter) And so how should we maybe start thinking about recruiting --? I mean, we have a shortage of students in the curriculum.

Munk: Yes.

Armi: Is there anything we maybe ought to change in that regard, so that we can recruit another Walter Munk or --?

Munk: Well, I think, ignoring your last comment, so what would come to my mind is we should care less about grade point averages and more about the kind

of -- whether people seem to have a spark in them, when you find out about what they've done. I mean, Werner had a spark in them. And then, of course, what's his name went off. Justin Lancaster. Now, you got -- Did you meet him?

Armi: No.

Munk: Now, Justin Lancaster -- But, of course, he's not a good example of a good career in oceanography. He was a lawyer. He wanted to go into oceanography. Werner is a better example. But, I mean, take Chip Cox, who's a brilliant man. He had a spark, you know. When I met him, and he was looking for things, he bought an old Navy boat and earned his keep by going tuna fishing once a week, and made enough money so he could live. Then he finally leased the boat to some man who was going to pay him rent and then took off to South America, and he never got the boat back. It didn't bother Chip very much. I mean, Chip obviously had a -- But I don't even know what his grades were. He may have been good too.

Armi: Yes.

Munk: Russ Davis. You know, a difficult man. But we hired him. And he was a chemist, you know. But he obviously was a person with (laughs) some kind of a -- little different, you know, not pliable. (laughs)

J. Munk: Where are the Per Scholander's? Where are the naturalists?

Munk: Wonderful. And, well, you'd certainly him because he was so mad. So that's what I'd say. Pay more attention to -- and less on grade points and more on whether they seem to have originality and spark.

Armi: [Right?].

Munk: Would you agree on that?

Armi: Oh, I would agree entirely.

J. Munk: Ginny used to get awfully angry at the biologists because they were just naming fishes instead of learning something about the environment. (inaudible).

Munk: Are you getting tired of talking to me?

Armi: Well, I think we've -- Or --

Munk: We've done it.

Armi: Yeah, I think --

Munk: I thought -- I'm dying to give you a drink.

Armi: Yeah, that sounds like a (laughter) grand idea! Well, we'll have a drink! And then we can talk about things that nobody'll ever know about!

Munk: But, you know, that's a -- It's so sweet of you to do that. You know, it really --

Armi: Well --

Munk: But I hope -- It was kind of fun, in a way, wasn't it?

Armi: Yeah, it was good fun. Well --

Munk: I put these in. And it makes you think a little.

J. Munk: Here's the other one, dear. Here's another one, [over here?].

Armi: Well -- [I thought?] I don't have to ever do this again.

Munk: Can I get you a glass of wine or something?

M1: Well, yeah, that might be good. (laughs)

Munk: OK. [Whitmurter?].

M1: Well, that'd be great.

J. Munk: I think Edie'll --

M1: Yeah.

J. Munk: -- bring it all out here, dear.

M1: Yeah.

J. Munk: And she's got it on a tray, the --

Munk: Is this Judy's?

M1: Well, I've just started to --

Munk: Because, you know, that's --

M1: -- feel it in my throat.

Munk: I think --

Armi: Those are yours -- I don't have --

M1: [In view?] of the talking --

Armi: Those --

Munk: Yes.

Armi: And the rest, it's all --

Munk: I guess they're all yours.

J. Munk: Walter, just tell Edie. She has it all --

END OF INTERVIEW