

The Woods Hole Oceanographic Institution holds copyright to this transcript and provides access to the material strictly for non-commercial educational and research purposes. No reproduction, transmission, or other use of this transcript that extends beyond fair use or other statutory exemptions is permitted without the prior written permission of the Woods Hole Oceanographic Institution.

The opinions expressed in this interview are those of the interviewee only. They do not represent the views of the Woods Hole Oceanographic Institution.

## **RICHARD BACKUS ORAL HISTORY**

**October 21, 29 and November 12, 24, 2003 Interview by Frank Taylor**

**Tape 4 of 4 tapes**

### **Woods Hole Oceanographic Institution**

1 TAYLOR: 3, 4, 5, 6, 7. It's November 24, 2003, and we're back at the Archives in the McLean  
2 Laboratory at the Woods Hole Oceanographic Institution for our fourth session with Dr. Richard  
3 Backus. And we've gone, in the previous three sessions, pretty much through all your early  
4 years, and got right up through a cruise and what it was like on a cruise, what it was like to be a  
5 Chief Scientist, you know, all those kinds of things. One of the things I wondered, though, when  
6 you collect everything, what do you do with it when it comes back up on ship?

7 BACKUS: Right. On the cruises that I made having to do with formal distribution patterns in  
8 the Atlantic, cruises on which we towed midwater trawls, each trawl haul was about two hours in  
9 duration, and what we'd catch would conveniently come out of the net into a plastic dishpan, and  
10 we'd shake the net out and clean it out so that there weren't stuff left in the net to contaminate  
11 the next haul. And we'd take it into the lab, and if there was any pieces of junk in it, which  
12 occasionally there were, we'd take them out. Then we'd pop the whole thing into a gallon jar.  
13 Generally that was enough to hold the catch. Sometimes a good haul would take two one-gallon  
14 jars. We'd put a label in, of course, telling what the haul number was. Then we'd add formalin  
15 to preserve the catch, so as to bring the solution, which was sea water with formalin to bring it to  
16 a 10 percent formalin solution, formalin or formaldehyde. That fixed, hardened the tissues of the  
17 specimens, and preserved them for substantially on the way to forever. We also added Borax to  
18 neutralize the formalin, to take away the acidic effect, which would be detrimental to the long-  
19 term preservation of the specimens. So that was about all we did as far as the collected material  
20 went, on the cruise itself. When we got back to Woods Hole, the very first thing we took off the

21 ship were the wooden boxes that held four one-gallon jars, and a few pickup loads would get  
22 what we caught back down to the lab. When we got there, over the next few days and weeks,  
23 we'd go through the washing of the samples--that is, we transferred them from the formalin,  
24 formaldehyde solution, through successive washes, just by pouring off the formalin, and then  
25 putting fresh water into the samples, letting them stand for a couple of days, then pouring off the  
26 wash water and renewing it until the odor of formalin was gone, and then we'd gradually run  
27 them up through alcohol, which was the permanent preservative, but a low percentage of alcohol  
28 at first, and gradually to the stronger solution of alcohol. Gradually because alcohol by osmosis  
29 would pull water out of the tissues of the fishes and shrink them, so they were transferred from  
30 formalin through water into alcohol gradually, and the alcohol was the final preservative. Then  
31 the collections were sorted. That is, we were interested in the fishes, and there were lots of other  
32 things in the collections as well as fishes. There were shrimps of various kinds and jellyfishes  
33 and salps and all sort of things, which stayed in the preserving solution as what we called "the  
34 invertebrate remainder." But we picked out the fishes, and then, of course, we had to sort the  
35 fishes into the constituent species. We ended up with all of one kind in a small jar of alcohol, a  
36 4-oz. jar, perhaps. That was generally big enough. Sometimes the larger specimens or larger  
37 collections of fish specimen required a quart jar. But anyhow. So we might end up with 20 or  
38 30 or even 40 sometimes smaller jars, each with a single species in it. But the midwater fish  
39 community in the ocean is fairly diverse, so that where you ended up with lots of jars. Then our  
40 ultimate interest was in identifying the lantern fishes, the species in the family Myctophidae,  
41 which were the ones that were useful to us in establishing patterns of pelagic-life distribution in  
42 erecting our scheme of faunal regions and provinces for the whole Atlantic. So that was the final  
43 step, was saying, "This Myctophid species is such and such for each collection." Count the  
44 number of specimens in the range of length of the specimens, and so a jar of a particular lantern-  
45 fish species was another data bit in our long-term project of studying the Atlantic-wide  
46 distribution of these species.

47 TAYLOR: What kind of data would you put together right onboard ship?

48 BACKUS: Right onboard ship of course there was the geographic position of the ship at the  
49 beginning and at the end of the tow. There was the depth of the net. There was the time that the  
50 net went overboard, and the time that the net got to the fishing depth, the time that the net began  
51 to be retrieved from the fishing depth, the time that the net came onboard--all those simple bits of

52 information about the elements of the capture of the specimens, nothing too complicated. But at  
53 the same time we had information about the temperature structure of the water column  
54 throughout the upper 200 meters of the water column--occasionally information for a few  
55 hundred meters below that. So with the information about the temperature structure of the water  
56 column we had a pretty good idea of where we were ecologically speaking, and of course, from  
57 the ship's position, information we got from the bridge, where we were geographically speaking.  
58 We also had information about the sound-scattering properties of the water column. That  
59 information had helped us choose depths to fish at.

60 TAYLOR: The thought just occurred to me, but with this talk about global warming and oceans  
61 warming, and all this kind of thing, would the studies you have done, could they possibly be used  
62 as an indicator of global warming?

63 BACKUS: Well, of course the ocean changes rather slowly with respect to the atmosphere,  
64 especially the terrestrial atmosphere. So that global warming . . . . If there's global warming--  
65 that is, the whole globe, all of earth warms--of course the oceans will warm too. But water  
66 changes its temperature much more slowly than air, of course. The two are obviously  
67 interrelated. But it takes a long time to change the temperature of the oceans. Although changes  
68 have been detected. I would think that physical oceanographers' data are what are most  
69 important here. What we found would not be particularly useful in studying global warming,  
70 although one might eventually, if global warming continues and the distribution of plants and  
71 animals change with it, as they will, the distribution patterns that we saw in the Atlantic would  
72 slowly change, and that would be very interesting to see. So we think we know how pelagic  
73 animals were distributed in the decades of the '70s and '80s.

74 TAYLOR: You know, I kind of wondered, because if the glaciers started moving from the north  
75 again, I probably would move south, and I'm wondering if the species that you studied would do  
76 the same kind of thing. And I have absolutely no idea what the temperature range is that those  
77 particular specimens can survive in. But what would push them out, what would make them  
78 uncomfortable, so that they might switch.

79 BACKUS: Sure, well some of them have . . . . I suppose it would probably not be so simple as  
80 getting this feeling, an organism feeling that its surroundings are too warm or too cold, but a  
81 whole complex of factors would be influencing one another and the whole thing would be  
82 changing gradually for difficult to follow reasons, I suppose. It's a complex problem, but if

83 global warming occurs, ocean warming certainly will occur and is occurring, and the distribution  
84 patterns of animals will change in ways not particularly easy to predict.

85 TAYLOR: You know, years ago when I was teaching, I used to tell the kids the story about one  
86 female scientist who had spent most of her career taking the temperatures at different depths on  
87 glaciers and whatnot. The kids kind of looked at me, “What in the world for?” But that did kind  
88 of establish a baseline to give us information later on, and the reason I asked you that questions  
89 was: talking with Red Wright the other day, and talking about shifts of water and things like  
90 that, and then I was thinking of your situation, where you were essentially setting up an atlas of  
91 midwater fish, a geographical atlas that at some point down the line, that geographical atlas that  
92 you worked on could just end up being sort of a baselines for further studies to see what kind of  
93 changes are taking place.

94 BACKUS: Right. Well, people aren’t as interested as they once were in the things that I was  
95 interested in, in the ocean-wide distribution of things, and it took us a long time to make the  
96 study that we did. We spent an awful lot of money doing it, in terms of ship time. It took a lot  
97 of money, a lot of patience, a lot of time, and some people have said that a survey like that will  
98 probably never be made again. So there would have to be pretty compelling reasons for doing it,  
99 which might come about.

100 TAYLOR: You never know.

101 BACKUS: You never know.

102 TAYLOR: But you bring up a very interesting point, because one of the things I see from  
103 scientists in your generation and mine, and particularly with biologists is that: you know now  
104 they’re not seeing it through an electron microscope. It’s probably something they’re not  
105 particularly interested in. And you folks, besides having the solid academic credentials, and you  
106 know setting up the good projects, and all that, were also basically naturalists, weren’t you?

107 BACKUS: Yeah, I can’t claim to be anything more than a naturalist, and that’s kind of a  
108 pejorative descriptor these days, I guess. Whereas 50 or 100 or 200 or however long ago it  
109 wasn’t, because naturalists are thought to take kind of a superficial, surface look at things. But  
110 the natural world was always of interest to me, and ultimately I was led to oceanography from  
111 that naturalist’s outlook. As a boy I was interested in butterflies and flowers and fish and frogs  
112 and all that stuff, so yeah, I was a naturalist and I still am, and not ashamed of it [laughs].

113 TAYLOR: You’re absolutely right. It’s taken on a different meaning. Darwin was a naturalist.

114 BACKUS: Right.

115 TAYLOR: However, to me, and you might comment on this, to me like the early WHOI  
116 biologists were in truth naturalists, 'cause some of 'em didn't even have degrees, as a matter of  
117 fact.

118 BACKUS: Henry Bigelow, who, if there is a founder of the Institution, he was it. He had to be  
119 described as a naturalist, and he would have accepted the title with pleasure.

120 TAYLOR: But that was the state of the art in those days, wasn't it?

121 BACKUS: Yeah, naturalists went out into the field and looked at things, and that's the sort of  
122 guy he was. He was smart enough to know there were lots of ways to look at things, and that  
123 there were other ways than the naturalist's way, I guess. And he saw to it that a diversity of  
124 people were brought to the Institution. He brought Selman Waksman to the Institution, for  
125 instance, just thought, well Selman Waksman was a bacteriologist and a Nobel prize winner,  
126 eventually, ultimately, and Dr. Bigelow said, "Hmm, what about bacteria in the ocean? Are  
127 bacteria a significant element in the life of the oceans?" So he said, "Well, let's get a real good  
128 guy and see if he'll come here," and just say, "Hey, have a look at bacteria in the oceans, will  
129 you?" He didn't dictate anything any more than that. He got Dr. Waksman here, and Dr.  
130 Waksman took a fresh look. So that's the kind of guy Bigelow was. He was a naturalist. I think  
131 one of the things that makes a naturalist a good thing is a broad view. And not too much a  
132 specialist. So Bigelow was a great man and I say a good naturalist, and more.

133 TAYLOR: The reason I brought that up in the first place is that I was reading over your notes  
134 that you gave me. You had observations of different kinds of bird life in there. You were on  
135 some islands and looking at birds and things like that. You kept an aquarium onboard ship.  
136 Those are the kind of things . . . . Maybe "naturalist" isn't even the best word. "Enthusiast"  
137 might be even a better word.

138 BACKUS: Well, we were enthusiasts for anything that was alive that we could look at during  
139 the course of these cruises. Yup, we were not too wrapped up in our own particular study so that  
140 we couldn't look at other things around us.

141 TAYLOR: You also mentioned the idea of specialization. I wonder, in your view, is that  
142 extreme specialization that we seem to do now a good thing or a bad thing, or a combination  
143 thereof, or should we be looking still at the bigger picture?

144 BACKUS: We specialized. Everybody has to specialize, because you can't do everything--at  
145 least not do everything well. So specialization is certainly necessary. I suppose the history of  
146 science shows that specialization became narrower and narrower and narrower. As we learned  
147 more and more and more, we had to specialize by dividing and redividing and redividing. But to  
148 enjoy life it seems to me one needs to have sort of a generalist's outlook and take a look at a lot  
149 of things that are going on. But specialization is certainly necessary. I think you can't do good  
150 work without specializing. But at the same time, being a generalist helps you to know how to  
151 specialize, I suppose, and gives you ideas that you can pass on to others for taking closer looks  
152 at.

153 TAYLOR: One of the things we haven't talked about in terms of explorations of your discipline  
154 is actually going down in the water. Back in the '60s, early '60s, the idea of the Institution  
155 having a submersible was highly controversial, and it turns out ultimately . . . . I can remember  
156 being in the Zurich train station last summer and wearing a tee shirt with *Alvin*, and having the  
157 porter say, "Alvin, Alvin!" He knew *Alvin*.

158 BACKUS: Yeah.

159 TAYLOR: Geologists and biologists have made particularly good use . . .

160 BACKUS: Yeah.

161 TAYLOR: . . . of the *Alvin*.

162 BACKUS: Yeah, I was up at a birthday party in Burlington, Vermont, last weekend. Most of  
163 the people at the birthday party were local people, but there were a few of us from away, and  
164 somebody asked me where I came from, and I said Woods Hole, Massachusetts, on Cape Cod.  
165 And they said, "Oh, did you work at one of the scientific labs there?" And I said, "Yeah, the  
166 Woods Hole Oceanographic Institution." And they said, "Is that where *Alvin* operates out of?"  
167 And I said, "Yeah." "You didn't ever get to go down in her, did you?" And I said, "Yeah, I  
168 did." "Woow!" they said. So there was a big dispute. I can't remember exactly how people  
169 divided on that. I think what we used to call the "water catchers" or maybe still do, the physical  
170 oceanographers . . . . There seemed to be less in it for them than for biologists who were  
171 interested in sea monsters of various kinds. But anyhow, even among biologists there was a big  
172 difference of opinion as to whether this was a good thing to try to do or not. It was obvious it  
173 was going to cost a lot of money, so people said, "Gee, let's spend the money improving the  
174 instrumentation that we lower into the ocean, and what are you going to see down there that you

175 can't see with cameras," which were developing rapidly then. Anyhow, there was a strong  
176 element among the biologists that this was . . . . I mean, we knew in a general sense what was  
177 down there, people argued. We knew in a general sense what's down there. So there are various  
178 ways to sample that community down there. You don't need to go down there in a submarine  
179 and look at it. Then there were others of us that said, "Well you don't really know what's down  
180 there." And nothing replaces the--what my friend Schevill used to call the--Mark I eyeball. He  
181 said, "Nothing beats the Mark I eyeball." And you really need to take that eyeball down there if  
182 you're going to really know what's down there. And there've got to be things down there that  
183 we can't conceive of. And of course that turned out to be the way it came out. There were  
184 things down there that we had no conception of. The hot springs is an obvious instance. So  
185 there was this big dispute. I was on the side of the people that wanted to go ahead with the  
186 submarine, and I can't claim any great prescience or highly developed intellectual argument for  
187 doing it. I just thought it sounded like fun. So I was all in favor of it. I wanted to go down  
188 there. I did have one particular reason for wanting to go down there. I'd seen a special case of  
189 the deep scattering layer out in the slope water--that is, the water between the edge of the  
190 continental shelf and the north edge of the gulf stream, a piece of water that extends kind of from  
191 Newfoundland to Cape Hatteras between the edge of the continental shelf and the northern edge  
192 of the Gulf Stream, "slope water." In the slope water we'd seen for quite a few years a special  
193 case of the deep scattering layer which was called "Alexander's acres." It was called  
194 "Alexander's acres" because it was named after the skipper of the Coast Guard cutter *Yamacraw*,  
195 which the Institution operated for a couple of years late in the 1950s. Sidney Alexander was the  
196 last skipper of her, I think, in 1958. I don't remember the year we gave up the *Yamacraw*, but I  
197 remember we did operate her in '57-58, maybe also in '59. But *Chain* came along in '59.  
198 Anyhow, this characteristic scattering layer, instead of giving sort of a salt and pepper  
199 granulation to the layer on the echosounder record, it gave kind of a haystack appearance to the  
200 record, one sort of haystack after another. Some people thought they looked like breasts, like  
201 mammary glands. And this vulgar . . . . Lt. Alexander, when he saw this come up on the  
202 echosounder record, when were out on the slope water in *Yamacraw*, he said, "Well that's what  
203 I'd like to walk over barefoot." So we called it Alexander's Acres. It was obvious that there  
204 were individual targets down there that were making these crescentic echo sequences, because  
205 as you approach a discrete target with the echosounder, first you see it along sort of a

206 hypotenuse, and then as you approach it the path down to it gets shorter and shorter, so that it  
207 appears to get nearer and nearer to you, and then as you go past it the path gradually increases  
208 until you're looking along an extreme hypotenuse, and then it disappears behind you. So what it  
209 does is make kind of a haystack echo sequence. So we didn't see anything in the other parts of  
210 the ocean much that looked anything like this, but this was characteristic of the slope water, and  
211 sometimes we'd run from south of New York to Cape Hatteras and record it continually for mile  
212 after mile after mile. This echosounder portrayal was so dramatic that of course we got very  
213 interested in what could possibly be causing it. And we towed nets in it, and of course you never  
214 know if what you catch is really what is doing the sound scattering. So when we first discovered  
215 this peculiar layer, "Alexander's Acres," I thought, "By gosh, the day will come when we have a  
216 submarine, and we'll go down there to the depth of this layer, and we'll have some kind of a  
217 sonar that looks out to the sides, and we'll pick up these same sound-scattering groups that we  
218 see from the surface with the echosounder. We'll see by looking horizontally with the sonar in  
219 the submarine, and we'll sneak up one of these groups, and when we get to this group we'll flick  
220 on the lights and look out the window and we'll know what it is!" So I was enthusiastic for the  
221 development of a deep submersible for that particular reason. But, as I say, for the more general  
222 reason that it sounded like fun, going down there and looking around, and I was beginning to tow  
223 nets at the same time that the deep submersible program was beginning, and of course I wanted  
224 to go down there and look around. So it seemed like an obviously good thing to do to, to me.  
225 But as I say, no particular wisdom on my part. It just sounded like fun and seemed to be a  
226 natural extension of the work that I was doing with nets and echosounders, was to go down in a  
227 submarine and look around. So I joined the group that was making noise about doing this, and I  
228 think Susan Bower's [SP?] book about *Alvin* has a list in the back of the book of the people that  
229 dived in her for the first yea many dives. And those of who had argued strenuously for going  
230 ahead with the program got early invitations to go diving in her. And I think I was No. 10 to go  
231 diving in her with Bill Rainnie over in Buzzards Bay. And I remember at the end of the dive, he  
232 asked me if I'd felt any claustrophobia. I said no. We didn't go very deep, but it was a full-  
233 fledged dive to about 30 feet or so. But it was exciting, and I remember there was a hacksaw  
234 lying in the bottom of the sphere. And I said, "What's the hacksaw for?" And he said, "Oh,  
235 well, if something goes wrong and we can't surface," he said, "you saw this bolt off with this  
236 hacksaw and that drops the ballast and then we pop up to the surface." I said, "That sounds good



237 to me.” Anyhow, that was a great deal of fun. So and then the program proceeded, and I  
238 suppose it was years after that I suppose, before I actually got to go diving in the *Alvin* for  
239 serious scientific purposes. It’s fascinating, but as it came about, I scheduled for a series of dives  
240 in her, I and my colleagues interested in the midwater. Almost everybody else that dived in her  
241 in those days had reasons for going down to the bottom. I had no reason for going to the bottom.  
242 I wanted to go down to these deep-scattering-layer levels where we regularly fished to see what  
243 we could see. And of course what I really wanted to do was go out there and dive on  
244 Alexander’s Acres, but you really couldn’t count on Alexander’s Acres being there. You had to  
245 schedule well in advance, and you didn’t know whether, in my case, Alexander’s Acres, the  
246 object of interest, you didn’t really know whether it was going to be there when you scheduled to  
247 dive or not. But anyhow, the people who dived just before us also were working out on the slope  
248 water, and they came in. (I forget who it was.) And they said, “Dick, Alexander’s Acres is out  
249 there.” So we went out there, and we did exactly what I’d dreamed about doing 10 or more years  
250 before. We went out there and we found, sure enough, ran the echosounder and saw that there  
251 was Alexander’s Acres at 180 fathoms or so. (That’s 350 meters, give or take a little.) We dove  
252 down to the level of the sound-scattering groups, we turned on the *Alvin* sonar--or it had been on,  
253 I suppose, throughout the course of the dive, anyhow. We picked up these strong targets, turned  
254 off the lights. We picked out a strong target out a few hundred yards ahead of us, and we went  
255 for this target. Marvin McAmis--I think he was the pilot, and it was Jim Craddock and I and  
256 Marvin McAmis. And we picked up this target, and when the sonar said range 0, that we’d  
257 closed the target, we turned on the lights and looked out the window. Wow! We were in the  
258 middle of a marvellous fish school of lantern fishes, the fishes that we’d been studying, silvery  
259 lantern fishes, about 3 inches long, thousands of them in a tight school. And Jim Craddock,  
260 whose area was identifying them with an eye, could look out the window and say, “Oh, yeah,  
261 that’s *ceratoscopelus maderensis*, and we did this repeatedly for the next few days, with various  
262 combinations of us going down, diving on these targets, sound-scattering groups, and closing on  
263 them with the submarine. The very first one we came into, McAmis grabbed the motion-picture  
264 camera, pointed it out the porthole and took a picture of this marvellous fish school as it flashed  
265 away from us, disturbed by us, by the lights, I suppose, and by the sound of the submarine,  
266 perhaps. Anyhow, that was an exciting experience, and basically that’s the substance of my  
267 experience diving in *Alvin*. We wrote a paper about that experience, of course, published in

268 *Science* magazine, about the identity of this particular sound-scattering layer, and its probable  
269 relationship to other deep-scattering layers. The curious thing about that experience in my mind  
270 is the fact that I dreamed the whole thing a decade before it happened, and in reality it came  
271 about exactly as in my daydream about it.

272 TAYLOR: An absolutely fascinating period in the history of oceanography, because you folks  
273 were the ones that did a lot of your own engineering, if you will, on instrumentation and things  
274 like that. You had to build a lot of stuff. I think I said the one I heard of before that was Galileo,  
275 and there wasn't much in between. Then you had to do the scientific research, but then you get  
276 your own spaceship--the *Alvin*, the submersible, and you actually got to fly out into that what  
277 they tried to popularize as "inner space" during that period. And you know the way you talk  
278 about it. That had to be a real "wow!" experience.

279 BACKUS: Oh yeah, that was very exciting, very exciting, a great pleasure as well.

280 TAYLOR: For any youngster that might listen to this, I love the fact that you said it was fun.

281 BACKUS: Right, yeah, I was visiting . . . . I have a friend named Wes Jackson who runs a place  
282 called the Land Institute in Salina, Kansas, and he's interested in developing perennial crops for  
283 prairie soils, crops for soils, for lands that are plowed every year now for wheat and corn and  
284 other such crops. He feels that, if we didn't have to plow, cultivate intensively those soils year  
285 after year after year we wouldn't lose so much by erosion. So his idea is to develop crops, food  
286 crops, such as wheat and corn that are perennial crops instead of annual crops as they are at  
287 present. Of course the regular vegetation of those prairie soils included many, many perennials,  
288 so that's sort of a natural vegetation cover of the prairie soils are these perennial plants. So  
289 anyhow I go out to Kansas once in a while and visit him, and he was taking me around the lab  
290 out there, which has been growing gradually. His work has been quite successful, and he's a  
291 terrific guy. So he was introducing me to a couple of young scientists that had just joined the  
292 organization. And they were telling me about what they were interested in, and how it related to  
293 the broader program of the organization. And I said, "Well, Wes may not like to hear me say  
294 this, but," I said, "fellas, if it's isn't fun, don't bother with it." [They laugh.] I think "Is it fun, or  
295 isn't it fun?" It's being fun, I think, identifies it as being something important to work on,  
296 especially something new and important to work on. I expect many scientists would disagree  
297 with that, but my attitude was, if it ain't fun, don't bother with it.

298 TAYLOR: I think of, as I say, all of those high-school kids I taught who were contemplating life  
299 in a grey cubicle, or maybe stepping out and doing something that might not be as financially  
300 rewarding but is more fun to work on. Certainly having value doesn't mean it can't be fun.

301 BACKUS: Right, exactly. That's right, no doubt about that.

302 TAYLOR: Were you ever apprehensive going down in the *Alvin*? I mean, it was a pretty new  
303 technology at the time, and not really tested.

304 BACKUS: No, I can dream myself into situations where I sense what claustrophobia is really  
305 like, but I never felt any claustrophobia in *Alvin*. The controlled atmosphere that one breathes  
306 was sweet--is the only word I can use for it. That was very good. There was nothing stuff about  
307 the atmosphere inside the sphere. That was very well regulated and was good. And of course  
308 the sphere was cool, cold maybe even somewhat, so that you weren't hot and sweaty and stuff,  
309 you were cool and in a sweet atmosphere, and so it was comfortable in that respect. The only  
310 uncomfortable thing about it was the positions that you had to take to look out, and that meant  
311 getting into awkward positions to look out the ports, and for some reason or other it got you in  
312 the thighs and I remember being lame for weeks afterwards in the thighs from the cramped  
313 positions that you got into to look out. That was the only uncomfortable thing about it. As far as  
314 apprehension or . . . . I had complete faith in these guys that engineered it and operated it, so I  
315 never had any apprehension at all. I figured they knew what they were doing and they did.  
316 'Course there was the accident that lost her. That happened right after I'd used her, when a  
317 cradle that lifted her out of the water and put her back in the water on *Lulu*, when the hoisting  
318 cables broke on that cradle and dropped her into the water just as they were launching her--that  
319 happened right after I used her, on the next cruise with her, so I sup . . .

320 [END OF SIDE 1]

321 TAYLOR: . . . were talking about going down in the *Alvin*.

322 BACKUS: Yeah, just reflecting for a moment on that accident and life on the *Lulu*. Yeah, the  
323 wire rope that the cradle--if you can call it a cradle--that *Alvin* rested on when she was out of the  
324 water, and which was lowered to put her into the water, was lifted by wire rope at the four  
325 corners of the cradle and wire rope doesn't like to go over winding surfaces that have too short a  
326 radius, 'cause the inside of the wire has a shorter path than the outside of the wire, and the  
327 elements in the wire saw against each other, and that's what ultimately leads to failure is one  
328 strand saws another strand, and the wire rope breaks, and that's what dumped *Alvin* into the

329 water. Life aboard *Lulu* was kind of interesting. See the *Lulu* was basically made out of two,  
330 long, big steel cylinders, and then bridged, connected so as to form a catamaran. And then there  
331 was a navigation bridge at one end. Inside one of the cylinders was basically the engine room.  
332 Inside the other cylinder were quarters for sleeping and eating. We always called that, living  
333 aboard her, was called “life in a sewer pipe.” Because whereas the atmosphere was sweet in the  
334 *Alvin* it was really stinko in the *Lulu*, with minimal ventilation and all these sweaty guys sleeping  
335 and eating and living in this cylinder. It was pretty bad, but it was worth putting up with for the  
336 pleasure and the excitement of going diving in the submersible. But there’s no question that the  
337 mode of operation that’s used at present is of course infinitely superior in many respects to what  
338 it was in the first days.

339 TAYLOR: Well, this whole evolution of all this technology that has gone on here. And now I  
340 saw in the paper a month, month and a half ago, talking about a new generation *Alvin*, that might  
341 be able to cover like 90 percent of the ocean’s floor, is kind of in the works.

342 BACKUS: Yeah, well I haven’t really kept up with developments there, except there’s been a  
343 great change in the way that she’s been used, and of course I believe she’s been used really well.  
344 Making her a national facility was a good thing. It was obvious that she was capable of  
345 outstripping the scientific demands that our relatively small institution could make on her, and  
346 that to get the most out of her, to get your money back as quickly as you could, you had to use  
347 her as much of the time as was prudent from a mechanical standpoint. So making her a national  
348 facility was a great thing, in that people from all over the nation, if not from all over the world,  
349 participate in her use, and that meant a great multiplication of the ideas that went into her  
350 utilization, the diversity of scientific problems that were attacked with her. It was a great thing.  
351 It was a great thing.

352 TAYLOR: She’s one of the really great changes you’ve seen over your tenure in science.

353 BACKUS: Right.

354 TAYLOR: One of ‘em you mention a national facility. When you first came, prior to UNOLS  
355 and all that kind of things, I don’t think the Institution ever would have grown to the size it is  
356 with the numbers of people working here, if they had to rely just on their own equipment, their  
357 own ships, and then UNOLS came along. *Alvin* became a national facility, and now you could  
358 go out on a University of Washington ship, or you could go out on a Scripps ship, or they could

359 come to us. They could apply for the use of the *Alvin*. So it really made a much better use of  
360 facilities, and allowed the field to continue to grow.

361 BACKUS: Yes, no doubt about that. So we were always at the forefront of conceiving of these  
362 programs and seeing them become more than just local affairs. I mean, the deep-drilling  
363 program--the Institution had a large part in the development of that program, for instance, which  
364 still goes on in one shape or another, another example of a very important national-international  
365 program that we had a strong hand in. So we were never a parochial organization, not from the  
366 start, in spite of being small and with limits, the Institution was always a far looking, good place.

367 TAYLOR: When you say that, "far looking," you're still talking a certain kind of person here. I  
368 think of UNOLS coming in. When it first came in, there was what, 12-13 institutions? It was a  
369 very small number, but they made the first secretary Bob Dinsmore, and Bob Dinsmore seemed  
370 to be the right guy at the right time in the right place with the right vision of how to run that thing  
371 and make it grow and prosper.

372 BACKUS: Right, yeah, and he was a Coast Guard officer looking for interesting things to do  
373 when his Coast Guard career ran out, and I think he saw this . . . . I know him but not terribly  
374 well. But he must have seen this as an organization where a person with ideas and energy could  
375 thrive. So he came here instead of going some other place, to our profit.

376 TAYLOR: Another huge change you've seen over your years here at the Institution, and in the  
377 field generally, is women coming onboard and actually getting to go out to sea and all that kind  
378 of thing.

379 BACKUS: Right. Well, that was a big crisis in the affairs of the Institution. Oh, I shouldn't say  
380 a big crisis, but it certainly caused minor crises, and in its way it was big because if you shut out  
381 women going to sea, you shut out 50 percent of your smart people, so that's obviously a dumb  
382 way to go. So there were all kinds of reasons given in the 1950s as to why women couldn't go to  
383 sea. None of these reasons were very good. Well, there weren't adequate living facilities.  
384 Women couldn't put up with the discomforts of going to sea. There was the touchy problem  
385 with toilets, and there was the whole morality of it. I mean, it would be terrible if sex got in the  
386 way of getting the work done, and even if it didn't get in the way of getting the work done, it  
387 would be terrible, and . . . . Anyhow, there were lots and lots of reasons for administrators  
388 saying that women shouldn't go to sea . . . couldn't go to sea. Basically the real reason why it  
389 was so difficult to get over this difficulty--the real reason of course is that for centuries or

390 millennia men have gone to sea to get away from women. That's the truth. I'm giving you the  
391 straight stuff here. Men have always gone to sea to get away from women, and they didn't want  
392 women around. They didn't want to have to be careful about swearing, and they didn't want to  
393 have to worry about looking spruce. They didn't want to worry about all the problems that  
394 women bring. Going to sea was an escape, time-honored way of getting away from women is to  
395 go to sea. So, basically, scientists, ships' crew, ships' officers--they didn't want women to go to  
396 sea. That's the real reason that women didn't go to sea. So all these shallow reasons why it was  
397 impractical or impossible for women to go to sea were continually raised, and of course they  
398 didn't make any sense, so eventually they failed in keeping women from going to sea, and  
399 women started going to sea. But it was a revolution, and there were some revolutionaries  
400 involved. One revolutionary that I think of was a woman named Roberta Eike, and I don't know  
401 if anybody's told you anything about Roberta Eike or not, and her experience, but Roberta Eike  
402 was a college student interested in copepod biology, and she got . . . and this I can't remember  
403 the year for sure, but this was about let's say 1955, plus or minus a year or two. Roberta Eike  
404 was perhaps a junior in college or something like that--I forget where, maybe Elmira College, a  
405 small college in New York State. And she got a summer student fellowship, I believe, at the  
406 Oceanographic Institution. In any case, she had what amounts to a job at the Institution, and she  
407 was working for George C. Clarke, who was a Harvard professor in the Biology Department at  
408 Harvard, and was at Harvard during the academic year and had a home in Woods Hole and a  
409 laboratory at the Woods Hole Oceanographic Institution in the summer. And he was one of the  
410 plank owners of *Atlantis*. He had towed nets coming across the Atlantic, joined the ship I guess  
411 in Copenhagen, or if not in Copenhagen in Plymouth, where she called on her initial voyage.  
412 George Clarke had come from Plymouth to Woods Hole and towed nets. He was interested in  
413 plankton biology, and light in the ocean, and how light affected ocean animals, and naturally  
414 occurring light in the ocean--bioluminescent organisms in the ocean. So anyhow Roberta Eike  
415 was working in the Clarke lab in the summer. I think it was her first summer at the Institution.  
416 The reason that I remember some of the details of this is that I had collaborated with Clarke in  
417 writing a couple of papers about the relationship between light level and the migrations of deep  
418 scattering layers, so I knew the people in his lab that summer and was working with him to some  
419 extent that summer. So anyhow there were two or three other people working with Clarke in the  
420 lab along with Roberta Eike, and they were given some ship time, maybe a week or so, on the

421 research vessel *Caryn*, which was a 90- or 100-foot ketch which had been built in Singapore and  
422 was a beautiful, beautiful ship. So anyhow, on the afternoon of the sailing, Roberta Eike had  
423 asked Professor Clarke if she couldn't . . . She wanted to go. She was a member of this  
424 laboratory group that was working on various problems, and the ship was going out to gather  
425 more data and make more observations, and of course she wanted to go. She didn't want to just  
426 do the shore-side part of the work. She wanted to go out and do the work on the water as well,  
427 perfectly natural. So she'd been asking Clarke to do this, and he said, "No, you can't go." "Why  
428 not?" Well, he gave all the usual reasons, and I don't suppose he spent too much time talking  
429 with her about this, but just told her no, it was Institution policy for women not to go, and no she  
430 couldn't go. And I suppose he attributed this to not just his feelings about it, but it was an  
431 Institution policy, so she went and saw Dr. Redfield, and Dr. Redfield said no, she couldn't go.  
432 So, let's see, Columbus Iselin was acting director of the lab at the time. Admiral Smith had  
433 retired as director, and Columbus was interim director until Paul Fye came. So Roberta went and  
434 asked Columbus if she could go. And Columbus said, "No, you can't go." So anyhow, she'd  
435 gone to the top and been told no. So anyhow that was that. When *Caryn* sailed, since I'd been  
436 working with the Clarke lab I went down to see them off and wish them well, and I got down  
437 there, and I expected to see Roberta Eike down there wishing them well too, and she wasn't  
438 there. And I said, "Where's Bobbie?" And they said, "Oh, she feels so badly about not going  
439 that she couldn't stand to come down and see us sail. She's gone to the library." And I said,  
440 "OK." Anyhow, that was not so. She was stowed away in the bilges, and so anyhow *Caryn*  
441 sailed. About midnight she got sick. It was a lousy place to stow away, and something bad  
442 could have happened to her. I mean, they were really stinky bilges, and anyhow she got sick,  
443 and she climbed up. She had lifted some hatch cover in the main saloon of the ship, and anyhow  
444 she got this hatch cover open and crawled out and lay down on a bench in the saloon. So  
445 anyhow, sometime, 1 o'clock in the morning or so, Bob Munns, who was the skipper of *Caryn*,  
446 came down to get himself a cup of coffee and found her there. And he was horrified, and he  
447 went and woke up George Clarke and said, "My God, there's a woman aboard." And George  
448 Clarke came out and found Bobbie there and spanked her.

449 TAYLOR: [Laughs] ho-oh, I'd like to see him get away with that today.

450 BACKUS: Oh, boy, he'd be in jail. Anyhow, so I believe that they turned the ship around and  
451 sailed back into Woods Hole, and put Bobbie ashore. And of course she didn't have any support

452 because, by going to the top of the Institution, and being told she couldn't go, she'd effectively  
453 eliminated all sources of appeal. I mean, she couldn't go to the director and say, "Oh, don't fire  
454 me, I . . . ." She'd already been to him, and he'd told her no, and she'd gone in spite of  
455 everybody. So she lost her job. A number of people argued on her behalf. I remember Joanne  
456 Starr[SP?] Malkus, who was a leading woman scientist at the Institution, made an appeal on her  
457 behalf, but it didn't go any good. I think her fellowship was taken away. I think that was her  
458 second year at the Institution. So anyhow, she was one of the revolutionaries, and that of course  
459 did nothing but damage her, but it certainly helped to call attention to the problem, and I suppose  
460 struck a blow for women going to sea. I don't remember how long it was after Bobbie Eike's  
461 stowing away it was that women began going to sea regularly, but Betty Bunce was one of the  
462 first that started going to sea regularly on Institution ships. I can't quite remember what *Chain*  
463 cruise it was, it was about *Chain* cruise 13 or something. I picked up *Chain*. I was Chief  
464 Scientist on a transatlantic voyage on *Chain* in which I joined the ship in Belfast, in Ireland, and  
465 I remember Brackett Hersey saying to me, "Now will it be OK if Betty Bunce joins the scientific  
466 party?" So there was still some . . . . And that was about 1960 or '61. I can't quite remember.  
467 So there was still sensitivity about, you know, "is it going to be OK if Betty Bunce is a member  
468 of the scientific party?" "Sure," I said. But I don't claim to be a hero that was fighting for  
469 women going to sea from the very start. I certainly acceded to it as it began to gather modest  
470 momentum. But I went to sea to get away from women to a certain extent too. Everybody did.  
471 [They laugh.] All the reasons for them not going just evaporated. I mean, people made  
472 ridiculous arguments like, "Well, there aren't toilets for women." Well, my god, toilets at home  
473 are not segregated--toilets, I mean. It's easy to have a toilet and a lock on the door and anybody  
474 can use it. I mean, my god! So one ridiculous argument after another just kind of evaporated  
475 and at the end of that there was nothing left to do except let women go to sea.

476 TAYLOR: And they have made amazing strides since that particular point.

477 BACKUS: Ohhh, as I said at the very outset, you shut out half of your talent by saying "women  
478 aren't going to participate." That's ridiculous!

479 TAYLOR: Well, you know, if you talk to some of the top women in the field today, they'll all  
480 say one thing, generally speaking the biologists were more supportive of women coming into the  
481 field early than a lot of the other fields.

482 BACKUS: I don't know why that would be except that I suppose women entered the field of



483 biology earlier perhaps or more of them entered the field of biology early than other fields--  
484 physical oceanography, geophysics.

485 TAYLOR: Well, you know, a biologist is dealing with living things. A geophysicist may be  
486 spending his life on squiggly lines on a chart. There's a different outlook here.

487 BACKUS: That's true. Yup, that's true. Women are certainly living things.

488 TAYLOR: With some great strengths and can do some things that I can't do.

489 BACKUS: Right, right. So anyhow that was . . . . And then I began to take women to see . . . .

490 I had some amusing experiences in connection with it, too. I forget. It was either *Atlantis II* or  
491 *Chain*, I don't remember, and we were at the end of a leg, and we were going into some foreign  
492 port. So I always made sure that we looked spiffy as far as the laboratories go, and as far as the  
493 afterdeck went. So I always passed out assignments: mop this deck, mop that deck, wash down  
494 these bench tops, do this, do that, do the other thing. They were all menial tasks. I don't think  
495 any of them were any more interesting or less onerous than others. But I'd asked this one young  
496 woman to swab the main lab desk. She said she wouldn't. She wouldn't. That was a job that  
497 was too often given to women, and she wasn't buying it. She wouldn't do it. So I said, "OK."  
498 [They laugh.] "I'll do it myself."

499 TAYLOR: I remember one time Betty Bunce came in here, and she said, "Well, do you have  
500 any coffee," so I asked one of the ladies out there to make some coffee. I was doing the thing  
501 with her, you know, I couldn't get up and make it. I remember the woman brought it in and said,  
502 "Here's your coffee, you sexist pig!" [They laugh.] Luckily it was said with a smile. But you  
503 know I understand where they're coming from. They always had to make the coffee. It was  
504 Susan[?] McDowell that told me she would be expected to pour the tea, you know, or something  
505 like that. So it's been interesting to see them come into the field and make real impact.

506 BACKUS: Oh, sure.

507 TAYLOR: But that's one of the big changes you've seen.

508 BACKUS: Um-hum.

509 TAYLOR: One of the things that really strikes me. You talk with such enthusiasm about what  
510 you've done here and about the Institution. Whatever made you decide to retire?

511 BACKUS: Oh, well I was just getting kind of tired, and competition for research money was  
512 getting tougher and tougher, and I just thought, you know, "you've had your shot at it." And I  
513 didn't have any particular . . . . Most of the ideas that I'd had I'd had a chance to work to

514 completion or exhaustion, and I just thought, well, “you’re 65, it’s probably time to stop and not  
515 drag it out.” I remember Paul Howland. Have you talked to Paul Howland? Great guy and one  
516 of the best skippers that we have ever had on our ships. His father was a master mariner, and  
517 Paul Howland started as . . . . I can remember Paul Howland from when he was a deckhand and  
518 either an ordinary seaman or an able-bodied seaman when I first knew him. I guess he was an  
519 ordinary seaman. I can remember him from that day until the day he was . . . . I made cruises  
520 with him on *Oceanus* when he was skipper--bright hardworking, genial man that was very fond  
521 of.

522 TAYLOR: Came up through the hawser hole, huh?

523 BACKUS: He came right up through the ranks. His father had been a master mariner, and I  
524 remember he told me a story once. This was when his father got to the retirement age, he retired,  
525 and Paul’s mother . . . . Maybe she got tired of having him kicking around the house. Anyhow,  
526 Paul said his mother said to his father once, “Well, why don’t you take a voyage as a relief  
527 skipper once in awhile? The company you worked for certainly want you too, and you’re still  
528 able.” And Paul’s father said to Paul’s mother, “When I was a young man I remember serving  
529 under some of these retired skippers who should have stayed retired. They were terrible, some of  
530 them. I’m never going to burden young folks the way those old bastards burdened me. I’m  
531 retired and I’m staying retired. There are plenty of good young men.” So that’s kind of the  
532 feeling that I had when I got to 65. I thought, 65 is a good time to retire. You’ve got other  
533 things you’re interested in.

534 TAYLOR: It’s been my experience in talking with you folks here, people of your caliber may  
535 physically retire, but you don’t stop doing work. What are you up to now? What have you been  
536 up to since?

537 BACKUS: Well, as an undergraduate I was a botany major. I retired on, I think it was, April 1,  
538 maybe it was April 30, 1988, when I was 65 and little bit more, a few months more. I stayed  
539 long enough that there were two people in the Biology Department. I was chairman of the  
540 Biology Department when I retired. There were two people who were up for tenure, whose cases  
541 (if you can call them that) I was carrying along and was interested in. And I was very admiring  
542 of those two people, so I stayed a few months after 65 just to see their tenure cases through  
543 completion. Then I retired. That was in the spring of 1988. And I had decided I was going to  
544 start studying the . . . . I was a botany major as an undergraduate, and I thought, well, I’m going

545 to start studying the botany of my town. So I pitched right in as flowers were blooming in the  
546 spring of 1988, starting to study the botany of Falmouth, which is a project that I haven't  
547 finished. But I worked very intensively at that for a number of years, got interested in the  
548 herbarium which is now in the space next to us here. Then in 1999 I worked at a botanical  
549 survey of Penikese Island and saw that project to completion with the publication of a paper  
550 about it a couple of years ago now. So that occupied a good deal of my energy. I like to write,  
551 so I've been writing--and I gave you a sample of the sort of stuff I've been writing, that  
552 description of *All* cruise 59. So I've been writing, I suppose what can best be described as  
553 memoirs. I've written stories about boyhood and a World War II memoir, and now I'm putting  
554 together a "life as an oceanographer" memoir. I've got a lot of pieces of that written that were  
555 written for particular purposes and need to be rewritten slightly, some of them a lot. And of  
556 course there are lots of unwritten pieces that I intend to write. But a lot of interesting things  
557 happened in 35 years here, and I'd like to describe as many of them as I can.

558 TAYLOR: So that's where your interests are nowadays.

559 BACKUS: Right, yeah.

560 TAYLOR: I was curious. The friend you have out in Kansas--did that relationship come  
561 through because of your later interest in doing the botany of this area, or was that something that  
562 predated that?

563 BACKUS: Well, I think I first got to know Wes Jackson through a guy named John Todd, who  
564 ran an offbeat institution called the New Alchemy Institute out in Hatchville, and I think it must  
565 have been John Todd who first introduced me to Wes Jackson. But Wes Jackson's a great  
566 character, a very interesting man, a good scientist, a plant geneticist and a character. I think it  
567 was through John Todd and New Alchemy Institute that I got to first know Wes Jackson.

568 TAYLOR: Well, see I wondered, because you know some of the ocean problems we have today,  
569 with fish depletion, moving to other locations, things like that are similar to the kind of things  
570 these plant guys work on, and we've lost all our root stock, the stuff that was highly resistant.  
571 We've got all these hybrids now. I understand the country of Peru is sitting on all their original  
572 potato seed stock like gold, just in case sort of thing. So I saw some real relationships, and I  
573 wondered if that was part of your tie-in with them.

574 BACKUS: Right, well it could have been, but it wasn't. I looked over there and saw a couple of  
575 names-- Charlie Parker and Charlie Yentsch, which reminded me that I'd made a list of . . . .

576 One night I was talking to Denise about talking to you, and I was talking about some people that  
577 you should talk that you may or may or may not have talked to. So Denise wrote them down in  
578 the dark in the car on top of a grocery shopping list, it looks like. [They laugh.] One is Rocky  
579 Miller. One is John Teal.

580 TAYLOR: OK, we've done John Teal.

581 BACKUS: Yeah. Have you done Rocky?

582 TAYLOR: No.

583 BACKUS: Well, Rocky goes a long way back. Dave Mash[SP?]?

584 TAYLOR: No.

585 BACKUS: Mack[SP?] Hulburt?

586 TAYLOR: No.

587 BACKUS: Rocky Bartlett?

588 TAYLOR: No.

589 BACKUS: John Hunt?

590 TAYLOR: Yes. And let me take that list, because we'll act on that. OK, great.

591 BACKUS: Rocky Bartlett lives in Maine now, but he's down here sometimes.

592 TAYLOR: Well, if they're away I can always do it by phone. I don't like to, particularly,  
593 because you miss a connection there, you know, like I'm doing Bud Froelich now by phone out  
594 in Minnesota, the guy that was instrumental in the *Alvin*, you know, from General Mills. And he  
595 sounds like a wonderful guy. He sent me all kinds of things, and he's very enthusiastic, but you  
596 know that give and take is really kind of important to this sort of thing.

597 BACKUS: Right.

598 TAYLOR: Let me ask you: you know my wife is a school librarian, and she invariably asks me  
599 this when I get home. What do you read for entertainment?

600 BACKUS: I mostly read nonfiction, but not entirely. But I read a certain amount of fiction, but  
601 let's see, what have I got lying at home now that I'm reading, which is probably fairly  
602 representative? I just finished a short book by James McPherson called [*Hallowed Ground:*] *A*  
603 *Walk at Gettysburg*, which is about the Battle of Gettysburg, that I've always been interested in.  
604 Another book that lying there is a book about Jamestown Colony in Virginia. It's called *Love*  
605 *and Hate in Jamestown*, and it's all about Captain John Smith and Pocahontas, and the founders

606 of Virginia Colony. The other thing that I'm into right now is a novel by Barbara Kingsolver  
607 called *The Poisonwood Bible*.

608 TAYLOR: That's a tough one.

609 BACKUS: I read *The Da Vinci Code* recently.

610 TAYLOR: Isn't that a great book?

611 BACKUS: Yeah. Well, I can never remember. People ask me, "What are you reading?" I can  
612 never . . . . What the hell am I reading? I'm rarely as successful as I have been just now in  
613 remembering [laughs].

614 TAYLOR: I say, my wife always asks because she is so pro reading, you know, like Harry  
615 Potter she loves because it's got kids reading that never read anything before. It's lines, it's a  
616 book, it's the printed word. And she always asks me. Now let me ask you one last question. Is  
617 there anything you thought I was going to ask you but didn't?

618 BACKUS: No, I don't think so. I'm sure there are things that we could talk about that we  
619 haven't. But that's not the same. No, I think . . . . Thank you for . . . . I think it's gone about  
620 like I thought it would.

621 TAYLOR: That's a little better than the two and a half hours they gave us in that colloquium.

622 BACKUS: As far as reading goes, that's another activity that I engage in to some extent. I'm on  
623 the board of the Penikese Island School, and the boys have to study out there as well as take care  
624 of themselves and so on. So there's a schoolhouse and a curriculum, and it's a regular thing.  
625 But the woman in charge of the academic program is Virginia Root&, and I've had some  
626 discussions with her about reading. I'm a big reading enthusiast. I figure if you get kids reading  
627 they're saved. And she's a big reading enthusiast. She figures if she can do one thing to help  
628 these delinquent boys it's to enjoy reading, and she's been quite successful at that, I think, but as  
629 near as I can make out parents that can get their kids reading with enthusiasm have basically  
630 solved the problem of child rearing.

631 TAYLOR: The kids used to ask me in school, "You think your course is the most important,  
632 don't you?" I said, "No, reading's the most important. You can't do any of our courses if you  
633 can't read." Plus, for the whole idea of pleasure.

634 [END OF SIDE 2, TAPE 4]