WOODS HOLE OCEANOGRAPHIC INSTITUTION

ORAL HISTORY OF SUSAN PETERSON

Interview by Frank Taylor, January 21, February 12, March 19, 2003

3rd of 3 tapes transcribed by Arel Lucas, May 2005

VOICE: Ready to go. All set.

TAYLOR: We are at the McLean Laboratory at the Woods Hole Oceanographic Institution in the middle of March, on a day that the snow is starting to disappear, and we have a little hope. As Dr. Peterson was just

PETERSON: Hhhhh!

TAYLOR: . . . pointing out, this is the first time she hasn't come for one of these when there hasn't been a snowstorm whistling around her ears. Dr. Peterson, over the past two sessions, we talked a lot about your early training, your time in Hawaii, when you came to the Institution and how you fit in here, and the kinds of things you did here, dealing with fisheries and all that. And you talked with such enthusiasm about it that I wondered why you left the Institution, why you decided to go on to other things.

PETERSON: [Laughs.] Well, that was easy. John Steele decided for me. I came up for promotion in 1984 and was denied promotion. So when you're denied promotion that's the same as getting fired. It's just a nicer way to phrase it. So I went to Boston University the next year, and taught and worked there for several years. I'd worked with a number of economists at Boston University when I was working . . . . The State Department had hired a number of academics to work on the Canadian-US boundary dispute, which was being adjudicated, and we, a group of about six or eight of us, from various universities and institutions here on the East Coast, advised the State Department about the fishing industry. Other colleagues here at the Oceanographic worked with the State Department on technical issues relating to the subsurface

geology and the morphology of Georges Bank and made technical arguments about why Georges Bank was a contiguous geological feature and it should all belong to the United States. The social scientists were looking at the fishing industry and the historical use of fishing grounds, and so I'd gotten to know this group at Boston University well. I admired the decisive way that they put a project together and followed it through, so when I got fired here I joined Boston University, interestingly enough in the Economics Department, where I, for the most part, did research, as I'd done at the Oceanographic. I had a number of grants that I took with me when I left, and what my idea had been was to develop a strong marine-policy group at Boston University to mimic or perhaps do better than the group down at the University of Rhode Island in their economics department. They had an excellent group of marine economists and other social scientists. I felt within Massachusetts we needed a group that had both the academic connection and the technical skills to provide specific support to the fishing industry and other parts of the maritime industry. At the Oceanographic, the emphasis had really been changing from practical support for marine industries to more I guess esoteric studies of marine policy, less practical, more theoretical. And I'm not theoretical; I'm practical. And so my idea was that we would form a group at BU, bringing together the technical expertise that had evolved around the Canadian-US boundary dispute, and then we could go out and change the world. I ended up staying at BU only for a couple of years. It turns out that John Silber, who was then president of BU, didn't think that BU ought to be any more applied than anyplace else. He wanted particularly the economics department to be theoretical, and so I was offered a job back in Woods Hole with a small nonprofit headed up by John Todd, an interesting fellow who had come to the Oceanographic in the Biology Department in the early 1970s. John is a Canadian, has worked a lot with integrated ecological processes. After he'd been at the Oceanographic for a few years, he left and founded the New Alchemy Institute, which is a well-known Cape organization that worked to translate scientific and technical expertise into things that could be used by individual homeowners or gardeners or farmers or whatever, and so he had experimented with aquaculture using wind power, solar power. He attracted a group of people in the early '70s who were attempting to change some of the ways agriculture was carried out, and it's interesting, because John Todd had an impact on a whole generation of Americans, and every now and then you still run into them. I mean Gary Hirshberg, who heads up Stonyfield Farm (yogurt), worked at New Alchemy and was one of the associates. So here's a fellow who learned

about natural systems and integrated ecological farming practices, and then translated that into a business, which now in the 1990s and 2000s is a very profitable, ecologically sound business.

TAYLOR: Let me ask you a question on this, because you're bringing up a very interesting point here. Your whole career has been sort of an amalgam of academic and very practical. You wanted to take the academic and see a result from it, see something happen.

PETERSON: That's right. [Laughs.] I didn't always get it. [They laugh.]

TAYLOR: To be sure. When BU . . . when you were there and then got involved with the New Alchemy Institute . . . . I can remember things at the New Alchemy Institute like indoors raising a certain kind of African fish.

PETERSON: Tilapia.

TAYLOR: Tilapia.

PETERSON: Yup.

TAYLOR: Where they'd have a long shaft coming from a propeller up on the roof that would turn water and change temperatures inside and things like this.

PETERSON: That's right.

TAYLOR: Was the climate at the Institution not good for this applied . . . to take the academic side and make it practical.

PETERSON: I'm not sure it was good or bad. The individual scientists at the Institution . . . . I mean Bill von Arx, who was a wonderful guy, had a lot of very practical inventions. He was working with thermal-exchange systems, essentially heat pumps, in the 1960s and '70s. John Ryther, in the Biology Department, worked to analyze the potential for using natural systems for wastewater treatment. When the ESL was built, it was originally built as sewage ponds, essentially, where the sewage was going to be transformed in some beneficial ways, looking at growing fish or shellfish or other things, but using the wastewater as a <u>nutrient</u> source. Ryther's early work was taken up by John Todd and then later by me. So the practical part appeared amongst individual scientists, but the institutional flavor was much more hard science, doing the theory and then the very technical, hard scientific part, much less interested in the application of that science as an institution. Individuals, of course, if they could do the hard science and still do the applied part, I don't know if they were penalized for it, but certainly a lot of them did it. But I think that you <u>had</u> to maintain your focus on doing <u>pure</u> science. That was what the Institution was known for and famous for, and that was what the administration <u>looked</u> for. And of course

the Policy Program was supposed to bridge that, was supposed to be looking at applications, but not in quite the hands-on way that I was interested in. So, does that . . . ?

TAYLOR: It does. It's interesting to me that then, and continuing on now, probably one of the biggest issues that we deal with in this country is fish stocks, over-fishing, sustainable sources.

PETERSON: Or lack of sustainables.

TAYLOR: Or lack of. If the argument that the fishing banks were geologically part of New England had been made prior to Canada planting the flag out there, there may have been a totally different result, and I guess I'm looking for you to comment on maybe an opinion [They laugh.] on where perhaps what you do should have come in a little more strongly.

PETERSON: Well, I think that it's difficult for the Institution to make that kind of shift from a basic science research institution to an applied institution. It has happened, and again it's individual scientists who have worked towards that. But I think if you were to do a poll of people in hard science, that they would say that one of the pleasures about the Oceanographic is that it's a place where you can go and do basic science, and to some extent what I'm describing is much the sort of thing one would do in a state university, where you have to do education, teaching and research, the three legs of the stool for a state land-grant college, and the Oceanographic isn't prepared to act like a land-grant college, so we shouldn't expect it to. So while there are times it's frustrating that the Oceanographic has such an extensive emphasis on hard science and just these bits and pieces of individuals poking out and doing applied science, in a way you need that, so it's difficult to be critical of the Institution as a whole. I think many of the scientists, as they've gotten tenure, have [laughingly] gotten more interested in doing applied things and have branched out, because the risks were reduced for them. There is a lot of applied work done here now, I mean currently Don Anderson in the Biology Department does a lot of work related to red time, and that has very practical implications for public health, for fishery stocks, for water-quality management issues. So it's pure science, but it slides directly into applied. Whereas, if you were to look at the work that Larry Madin and Rich Harbison do on salps and other wonderful gelatinous items that float around in the ocean, it's a little more difficult to see how that fits in with an applied . . . . It's absolutely wonderful basic science, but they're not edible, [They laugh.] so I don't know what you'd with them. So the Institution is what the Institution is, and so we can't expect it to be just what I want.

TAYLOR: And you found essentially the same kind of attitude at BU?

PETERSON: Yeah. John Silber was a very hands-on president, and he decided to remake the Economics Department, and at that point most of us left, because I mean we could see the handwriting on the wall. One of my colleagues, Dave Turkelow[SP?], went to U. Mass. Boston, where he continues to work on marine-related issues. They have an excellent marine-policy program at U. Mass. Boston, and he fits perfectly into that. So we're still out there as a network of people, but I think what you see at the Oceanographic is things rise and fall in popularity, and if you're here at the time that it's rising in popularity, that's great, and if you're here at the time it's falling, you lose out. But maybe that's true of all institutions, and I just am not so familiar.

TAYLOR: Now how did you come to know the people at the New Alchemy Institute?

PETERSON: Oh, well, it's just down the road--or was just down the road. It's not there any more. John Todd was still actively involved in the Oceanographic when I got here in the early '70s. He'd just left to start New Alchemy. Because of the emphasis there on aquaculture, I went out and took the tour, introduced myself, and started talking with John about some of the things that I was doing, and then just over the years we kept in touch. Dick Backus--in whose lab I sat for years down in Redfield--his wife Denise worked at New Alchemy, so I kept in touch that way. John Todd is a very outspoken and very aggressive seeker of new technologies and sort of ecological truth, and his work is quite public, and so it was easy to keep track of him in the newsletters and in the magazines and so on and forth. So he and I had kept in touch over the years. I'd done some work on aquaculture, done some work in the Philippines, and when we could all see the handwriting on the wall at BU, John had just left New Alchemy and started a new little nonprofit in Woods Hole, and he had originally wanted to work on sail-assisted fishing vessels and had built some and had applied them down in Costa Rica, which is a great idea for Second-World and Third-World countries because of the cost of fuel and the problems with maintaining engines or outboard motors, and so on and so forth. It also met his love of sailing, but when I came to work with John he had just started working with some colleagues, using a combination of aquaculture and wastewater treatment following on the work that John Ryther had done in the '60s and '70s, following on John Todd's own work at New Alchemy, and I was very interested in the wastewater part of the research and its application. The history of wastewater management in the United States is a really interesting one, and I can talk about wastewater till the cows come home, but mostly what we've done in the United States is to take the wastewater and to pipe it away, and "away" can be anyplace. We can pipe it into a river. We

can pipe it into the ocean, just away. And the concept of using the wastewater, treating it and using it for groundwater recharge just was not out there. "Away" was the whole issue, and so early wastewater treatment was, for the most part, done by guys who designed pipes. Pipes and pumps: that was what wastewater treatment was, and it really wasn't until the 1930s and '40s that people began looking at other characteristics of wastewater, the mechanics of settling it out and what to do the solids once they were settled, and what to do with the liquids, and disinfection techniques, and so on and so forth. For the most part it was treated in a mechanical way, and in the '60s and '70s there was a small movement within the engineering industry to start incorporating some of the biology, in part because they had to. They noticed that a lot of the mechanical treatment of wastewater had effects, and they may be foaming. There're things that happen. Well, why do those happen? Well, they happen because of the biology. So, in the '60s and '70s people became a little more sophisticated about the biology of wastewater. They began looking at the organisms at the lived in them. What were the microbial populations like? How were they supported? What did they do? And it really wasn't until the 1970s that applied microbiology began to work its way into wastewater treatment, where you actually wanted to take known microbial functions and harness them to achieve an outcome. And my interest was: I wanted the wastewater to be clean because we were not so slowly polluting the coastal ocean, and as we polluted the coastal ocean we reduced shellfish and shellfishing opportunities because of contamination. That was the first call. Shellfish beds were closed because they were contaminated with pathogens. The second thing that we were doing was, as we contaminated the coastal ocean with untreated wastewater, the nutrient enrichment was changing the biology, the biota, and we were changing the oxygen characteristics of the coastal water. We were making little dead zones. We were killing off fish, not just making them inedible but actually changing habitat for shellfish in particular, but also the nursery area for the small finfish that came in, and we'd had decades of marsh destruction, of marsh filling and dredging, and so on and so forth.

TAYLOR: The nursery ground.

PETERSON: The nursery grounds of the fishing industry, so we'd had mechanical changes, and then what we began seeing in the '50s, '60s, and 70s were ecological changes--biology and chemistry. So that not only were we smushing them or covering them, we were altering the chemistry of the coastal waters--all of this to the detriment of the fishing stock. So remember I started all this doing fish, so it does have a connection. So I was looking for a way to change the

world, to make wastewater treatment more integrated into communities, to change the "pipe it away" philosophy, to treat it locally, reuse it. John Todd's technical combination of aquaculture we then combined with . . . . My husband, John Teal, has done work on salt marshes for decades. He'd done some great experiments on Sippewissett Marsh, where they had looked at the capacity of Sippewissett Marsh to deal with various levels of nutrients, and they had in fact added synthetic sewage. I mean it really wasn't synthetic. It was either Milorganite, which is the sewage/sludge/fertilizer from the city of Milwaukee, or another wonderful product called Chicagrow, and that comes from the city of Chicago, and they would take these fertilizers and mix them in a slurry and spread them out over the marsh in various configurations to do experiments to see how well the marsh assimilated wastewater, looking at the biogeochemical processes. So what we did in our new little sewage attempt was to combine the aquaculture/fish/vegetation/aerated-pond portion with constructed wetlands, and devised a technology for wastewater treatment that was both physically attractive, mechanically simple, biologically robust, and we first applied it at the Sugarbush Ski Resort up in Vermont in the early 1980s. We built a little treatment plant up there that was tremendous fun. I mean first of all it was physically just absolutely beautiful. We had trout growing in the tanks, and we had a wonderful lagoon filled with all kinds of floating and racked plants, and we had a little constructed wetland and so forth. That was the basis for the data collection that we used to expand the technology. Our next foray into municipal wastewater treatment was here in Massachusetts, where we got a grant from a state agency that had been founded under the Dukakis Administration as part of his Centers of Excellence Program. It was headed up by Megan Jones, who's a Falmouth resident, and we got a grant to experiment with this natural technology that John Todd had named solar aquatics, in Harwich. The Town of Harwich is here on the Cape. It's a wonderful little town. It has no sewage that's piped. Each house has a septic tank, and following the septic tank there's a leaching field where the liquid portion is disposed of. The septic tank, where the solids settle out, has to be pumped every two to three years. Everybody should listen to this. Pump it every two to three years. I promise: that's the thing to do. So that material has to be pumped out, and it has to <u>go</u> somewhere. Well, we don't have a lot of places to take it on the Cape. In some places you can put it in a wastewater-treatment plant. At the time Falmouth didn't have one. Hyannis had one. It was full to bursting. What they'd done in Harwich was at the landfill they'd dug a big hole, and they put it in a hole in the

ground. And these holes in the ground are called lagoons, which is funny. I just think it's a wonderful word, because most of the time in your life when you think of a lagoon you're somewhere in the tropics, and it's blue and it's beautiful, and it has beaches. Well, septage lagoons are not blue, beautiful. I mean the only thing it had in common was because it was on the Cape it had a lot of sand. So here's a hole in the ground made of sand, pretty coarse sand, and the Cape is so interesting. If you were look at the side view of the Cape, there's ocean on each side. There's the Bay and the Sound, and then it kind of rises up in this sandy mound, and if you were to map it, you'd find that the drinking water's there in the middle, OK? And then if you went and mapped all of the landfills, you'd find they're all at the top of this little hump of sand, because of course the land on the edge, where the ocean is, is too valuable. You wouldn't put your landfill down there, so you put it away, and so the furthest you can get away is to the middle. So the landfills are sitting right on top of the aquifer, and each landfill had one of these little lagoons, these holes in the ground, into which people poured waste, and of course the liquid portion gradually seeped through the sand--not so gradually seeped through the sand--carrying very high nutrient loading, into the groundwater and down gradient, in the case of Harwich, into some cranberry bogs, and then into some ponds, and so on and so forth. The cranberry-bog owner had sued the town, claiming that his crop had been affected, and it had been. He was growing the most beautiful cranberry plants. You'd go out there, and it was gorgeous, but the plants were so big and so lush that they shaded the berries, and the berries didn't ripen, because it was being over-fertilized by the up-gradient flow. So we proposed a summer-long experiment where we were going to use this solar aquatics technology to set up a little outdoor thing and pump the stuff out of the lagoon, run it through our thing, and then discharge it back into the lagoon. And we thought, "This is good." We wrote up a little protocol. We went through all this stuff. We got permission from the town. We notified the State Department of Environmental Protection that we were going to be pumping it out, putting it back in, and we set the thing up and started running it, and it was a great experiment. We had two parallel lines. We had a very um strategic data-collection process. We were really looking at what happened, unit by unit, tank by tank. We were using these Calwall clear-sided tanks similar to what you saw at New Alchemy, filled with this [laughingly] lovely dark liquid. [Laughs.] Septage is quite black. Sewage is a little watery. I mean it's not quite like my drinking water, but sewage doesn't look like sewage. Septage looks like the real stuff, and there were 20 tanks in a row followed by a

little wetland, and what was wonderful about it is as you looked at it, particularly with the sun behind it, you could see it black at the beginning and then gradually lighten up, through these clear-sided tanks, till by the time it entered the wetland it was quite clean, and then after it flowed through the wetland it was very clean. We got excellent pathogen removal, excellent nutrient removal. It was a wonderful experiment. Partway through it, we were given an order by DEP to shut it down. We were accused of operating a wastewater treatment plant without a permit. And um we were notified that we were going to be fined $10,000, and the town was going to be fined as well. I think maybe they were going to be fined more, or maybe they were fined $10,000, and we were fined $5,000. We all appealed it, of course, but DEP was a little bit humorless. DEP was a regulatory agency, not a research agency, and they felt we were running a wastewater-treatment plant without a permit, even though we weren't taking . . . . We took it out. We put it right back in where we got it. It didn't . . . . They were very cross. At that point, what we were doing was quite public, and so what we tried to do, and I must say ineptly on my part, we tried to change DEP to allow more research, and to become more interested in not just fining people or issuing consent orders or whatever, but saying, "Look, we have a need for new technology to treat wastewater. It has to be developed somewhere. Here's a group of people who know what they're doing. Why not encourage them to do it?" Well, they eventually did change, and now, 15 years later, DEP has a really excellent program for innovative technologies, a way for evaluating it, and so on and so forth. In those times, it was "Just say no." [Laughs.] It was awful.

TAYLOR: I've got to interrupt you right here because what you were doing was very necessary and very laudable, and it was a wonderful combination of using science, policy, things like this to come out with some kind of practical, good, environmental thing. But a real Pandora's Box gets opened in that situation. The government gets involved in that. Mass. Water Resources Authority get great publicity by skimming Boston Harbor and all that, and building a $90,000,000 plant over in Quincy to produce organic fertilizer for the citizens of the State of Massachusetts, which they did for a very short period, but then sold the stuff that we were paying for to Florida at a very low price for their orange trees, and it's no longer available to us, and also it started to go a little bit downhill. It got out of the media realm, if you will. Can you [laughingly] involve us in your problems and how you saw all that kind of thing affecting what you were doing?

PETERSON: [Laughs.] Well, the plan to restore Boston Harbor was in the works at the time I was doing all this, and they hadn't started building the new treatment plant or the pelletization plant. I met with Paul Levy, who was then the head of MWRA. John Todd and I went to meet with him, and we suggested that instead of continuing to pipe all the wastewater to the new plant in Boston Harbor and then this long pipe out into Cape Cod Bay, that instead the city devise wastewater-treatment plants along the median in 128 that would take the wastewater, treat it, and then redistribute it as groundwater recharge in the communities around the Greater Boston area, because it seems silly to take all that water from Quabbin Reservoir in the middle of the state, run it into Boston, use it once, and dump it in the ocean. So that was our proposal, and we said you could do it less expensively. You wouldn't have to build the pipeline. The land was there. They eventually did build a prison in one of those median strips, but anyway that didn't go over very well. We also thought politically it was better, because it would be spreading the problem out amongst everybody, rather than focusing it in one place in the Harbor. So we were active politically. We were active with the press. We cultivated the technical writers from the various media. We got very good publicity, in part because what we were suggesting was so practical and so simple, and so beautiful. If wastewater-treatment were attractive and of interest to people they wouldn't be so anxious to pipe it away, so we shouldn't work so hard to make it ugly. So our idea was to make it something that the general public could be . . . . I mean they didn't have to be as involved in it as we were, but they at least needed to know where it went, and I can recall, maybe 10 or 12 years ago I gave a talk to a regional League of Women Voters conference, and there must have been 250 women in the room, and it was a lunch meeting. I was going to talk about sewage, and I started out the meeting by asking them for a show of hands. I said, "OK, just a quick question now. How many of you are on a sewer system? Raise your hands," and some hands went up. "And how many of you are on a septic system?" And some hands went up, and then I said, "And how many of you don't know?" And a whole bunch of hands went up. And it wasn't just the League of Women Voters. I mean I asked it at public meetings. I asked it for kids. I asked it for . . . . It could have been any group. A lot of people don't know what happens to their wastewater. It's part of the flush-and-forget mentality that we have. So what I wanted to do was not get everybody intimately involved in the subject of wastewater, but at least kind of raise it in the consciousness--not just the dollars, but the ecological consequences of continuing to treat it as waste rather than resource. So we wrote technical publications. We

wrote popular publications. We tried to improve our database. The thing that happened out of the Harwich summer experiment was it attracted the interest of some scientists, both as competitors and as detractors, and the best part about it from my point of view was that it attracted an investor who wanted to start up a company treating the wastewater using this new technology, because he could just see these blossoming in little towns all over the place--towns where's an old village center, where everybody had these little septic systems or failing cesspools or whatever, where you could go in and you'd build one of these really pretty little systems, and you'd clean up that town center, and then moving on to the next one. The investor's name was Barry Silverstein. He's a great guy, made his money on cable TV, and he set up a little company, and I was president, and we had a board of directors. I hired a few people, and we went around working to first get our system permitted by the state, accepted as a technology that could be used by a municipality, and secondly to get it permitted outside Massachusetts. We built a full-scale septage treatment plant in Harwich at their landfill and ran it for two and a half years with engineering oversight by a firm that we had hired, by a firm that the state had selected. We spent over a million dollars validating the technology and also refining it, figuring out how we could do things better, getting some of the equipment issues dealt with--oxygen transfer, which kinds of pumps worked better and so and so forth. It was a tremendous learning experience for all of us. We really learned about the material. We learned about how to handle it. We learned about the variability in it. It comes in truck by truck, and each individual house has its own quirks, and so when you get it, no two truckloads are alike. It's not like sewage: it all comes down the pipe; it all looks the same. So we really developed an excellent database on septage, which has now been used broadly for other applications of treatment technologies. After we finished the Harwich pilot, we went on to build . . . . We had treatment plants down in Providence, at the Narragansett Bay Commission's main facility, where we treated sewage. We had a small facility in Marion, where we treated boat-waste pumpout and septage. We wanted to expand the system up in Sugarbush, but the state regulatory folks up there didn't have the patience to wait for us to get our data in shape, so they required Sugarbush to build a breakpoint chlorination plant, probably . . . . [Tape stops and starts again.] It's not a good technology in your neighborhood.

TAYLOR: During the early part of all this, was this highly frustrating to you?

PETERSON: Oh, of course it was frustrating because they were so many . . . . I mean there's the political, the regulatory, the technical, the scientific, and having to worry about the money and employees and getting contracts and everything. It was a wonderful challenge too. I had a great time. I liked the innovative technology piece. I liked setting up the research protocols and then collecting the data and looking at the data. I liked looking at the numbers. OK, if we do it this way, what does it cost? If we do it that way, what does it cost? Can we . . . ? I also liked looking at the financing alternatives--different ways that municipalities could use to finance this sort of thing rather than just doing the standard borrowing money through the state and federal governments, relying on grants to do this. I wanted to make it affordable so the municipality didn't have to jump through all these hoops in order to get these strange dollars that then required them to spend a couple hundred percent more than they needed to spend for a system. The Falmouth Wastewater Treatment Plant is a perfect example of what not to do. I mean it was 1940s technology built in the 1980s and failing in the 1980s, 1990s and 2000s. So it was challenging. It was frustrating. It was fun. But ultimately it was wearing. We did end up building wastewater-treatment plants in lots of places. We built one in Mexico, quite a few up in Canada. We treated high-strength ammonia out of a fertilizer manufacturer up in Alberta. We had some plants using the technology built in France, but after 10 years of doing it, I left. I retired. I'd gotten good at it. I'd gotten frustrated by it. I'd gotten tired of the hassles of running a small business. The economy was strange. It was harder and harder to get money. I had wonderful employees, but . . . . So six years ago I retired from the company, which was called Ecological Engineering. It still exists. It's up in Weston, Massachusetts. It's run by my partner.

TAYLOR: But it's so difficult to convince people to deal with something that is out of their sight and out of their mind. I've often claimed if smokers turned black on the outside rather than the inside there'd be a lot less [??] smokers around.

PETERSON: [Laughs.] Well, there remains a really strong interest in wastewater. If you look at town by town here on the Cape, in particular, it's one of the larger problems that the municipal government has to deal with--the selectmen, the board of health, the department of public works. With huge population changes, and particularly here seasonal population changes, it's a very difficult problem. Water and wastewater--it's what attracts people to live here, and it may be what makes them leave. If we can't keep the drinking water drinkable and the wastewater out of the ocean, we know that in a very short time we've made measurable changes, all for the bad, in

the coastal waters around the Cape, and it's not too late to reverse it, but we have to get our act together and do it.

TAYLOR: Now, is this something you're still championing?

PETERSON: This I what I'm still doing. I spent all those years in the very applied business side of things, trying to sell technology, and I found it was an uphill battle. For one thing, I was competing with very large engineering companies who were used to a mode of operating that didn't include innovative technology. They were attracted by it. It had sex appeal. We got a lot of requests from citizens' groups, but when it translated to actually what they were going to build in this community--a, b or c--they always took the advice of their consulting engineer, and the consulting engineer always said, "We should build what we've built before, because we know how to do it." Even though they don't work very well, that didn't make any difference. They weren't interested in performance. They were interested in meeting the codes. I mean they weren't disinterested in performance. I shouldn't . . . . I mean the engineering community is very concerned that a lot of wastewater-treatment plants don't work, but . . . .

TAYLOR: But they still take basically a conservative approach.

PETERSON: So they are. I mean otherwise they wouldn't be engineers. So it was . . . . I was trying to create a massive culture change and succeeding in small areas, but ultimately it became too frustrating. So in the intervening years while I was doing that, I was doing a lot of other things too. I was one of the founders of the Coalition for Buzzards Bay, which is a marvelous regional organization, and I was first president of the Board of Directors, and my husband was here at the Oceanographic, where he'd been for decades.

TAYLOR: He's a biologist.

PETERSON: John's a biologist, born in Omaha, Nebraska, undergraduate and graduate work at Harvard. He married as an undergraduate to Mildred Teal, and they--after he finished his Ph.D.--moved to Georgia, at the Sapelo Island Research Station, where they were for several years. Their first child, Eric, was born when he was in graduate school, and then their daughter Tanya was born down in Georgia. Then he went up to Dalhousie, where they were just starting the oceanography department up there. He stayed there for a couple of years and then came down here to the Oceanographic in the early '60s. So he'd been in Woods Hole in the'50s at the National Marine Fisheries Service lab doing research as an undergraduate and as a graduate student, so he came back to Woods Hole and joined the staff. His work has been some deep-

ocean work. He knows a lot about hydrocarbons in the ocean. He's done work with large fish, sharks and so forth, and then a lot of work on salt marshes. That work started in Georgia, where that's what there was, and just extended to work here at the Oceanographic. So he's done a lot of work on oil pollution, was an advisor to the Minerals Management Service for decades--as was I. I was advisor to the regional office, and he was advisor to the national office, so we got to do some great trips together. We got to tour the Exxon *Valdez* spill site soon after it happened, and saw the bird-recovery program up there and looked at some of the cleanup technologies. About in the early 1990s John was approached by a company down in New Jersey--Public Service Electric and Gas--that was required to build cooling towers for their nuclear power plant, because of the effect their once-through cooling system was having on fish populations, on the larvae and juvenile fish at the intake stations. The company said, "We don't want to build a cooling tower because this nuclear power plant is already old and that's very expensive." So they proposed mitigation, where they would upgrade their once-through cooling system, but then restore salt marsh in order to introduce new habitat for fish and sort of make up for the fish that had been killed. There is an end to this story, because it fits in with what I'm doing now. John was hired as an advisor to the company in planning--first to find out whether or not mitigation was possible (How much marsh did you need?), and then in the actual process of marsh restoration, which he's been doing now for 10 year. It's 32 square miles. It's a huge site. It's been wonderful. I've also been involved on it. They're a great company. They worked very hard, not only to restore the marsh. They have an active public education program. They've made the marsh available for school groups, for hunters, for fishermen, but what it did was take a lot of the work that I'd been doing on the constructed wetlands side for wastewater treatment and look at the technology for marsh restoration, and then John and I had established our own consulting company soon after we married in the late '70s, because we did do some work, and we wanted a corporate structure, but it was sort of a . . . . People would call you up and you'd do a little job here, a little job there. At this point he retired from the Oceanographic. I retired to Ecological Engineering, and we now do consulting full time on all kinds of wonderful . . . . Some are wastewater. Some are wetlands restoration. Some are both projects.

TAYLOR: You're so academically compatible in the kinds of things you do. Is this the kind of thing you kick around in the evening?

PETERSON: Oh, yeah, I mean we're always talking about this kind of stuff at dinner. I mean it's a slow meal if you haven't talked about sewage or wetlands protection or whatever. But we work together very well. I don't know if I got to this part, but in the late '70s we bought a hundred-acre farm in Rochester, Massachusetts, just over the bridge, and an old house and restored the house and sold it, and then built a solar house out in the woods, and then later acquired another 50 acres, and we've been building buildings ever since. I mean we've got sheds and barns and chicken coops and all kinds of things. We raise sheep and we keep chickens and ducks and geese, and keep a couple of pigs. Every year . . . . I just took the pigs to the slaughterhouse yesterday morning. And we have haying equipment and we do our own hay. We have largely forested land, and we have a managed woodlot, and it's harvested both for firewood and for white pine, which is the dominant crop here. So between the farming and the consulting we stay physically active and we have a pretty good time.

TAYLOR: It's amazing. The things that you've been involved with since you went to Hawaii, went to the University of Hawaii, are all things that have really gotten big on the national and international stage over the years. I will listen to Roger Berkowitz still, . . .

PETERSON: [Laughs.]

TAYLOR: . . . his sustainable stocks that he uses in his restaurants.

PETERSON: That's right.

TAYLOR: That's the fisheries kind of thing. Way back 50-60 years ago they were having trouble on Long Island with waste flowing off--I forget whether it was a duck farm or a goose farm or something like this.

PETERSON: Duck. It was a duck farm.

TAYLOR: OK, out into Long Island Sound. And yet a lot of that stuff still goes on.

[END OF SIDE 1; last several paragraphs repeated on SIDE 2]

PETERSON: Well, it's interesting you bring up the Long Island example, because here in the Greater Woods Hole community, there are a number of people who experimented with these natural technologies. George Woodwell, who's the head of the Woods Hole Research Center, built a wastewater wetland on Long Island 30 or 35 years ago, and then, just before he came up here, he joined the Ecosystems Center at MBL and then went on to found the Woods Hole Research Center, so when you kind of scratch below the surface of the scientific community in the Greater Woods Hole area, you find out that a <u>lot</u> of people have experimented with natural

systems, with constructive wetlands, with ponds, wetland, aquaculture systems. The idea of integrated ecological systems has been out there, but it's just now really beginning to coalesce. We're beginning to see more and more requirements that things be done ecologically rather than mechanically--for a couple of reasons. The ecological systems are more robust. The parts don't break. They're less likely to wear out. [Laughs.] And operating costs are lower. So we're beginning to make headway. New York State has just adopted a stormwater-management model, which essentially uses constructed wetlands of various sizes and shapes to manage stormwater coming off roads and parking lots. Well, it used to be what you did with stormwater was you put it through a catchment basin, which is a concrete thing, so the grit would fall out, and then it overflowed into a ditch, and the ditch went into a stream. The stream went into a river. And the idea was to get it to move as fast as possible, so everything was hard piped, and you could move that stormwater off fast, but it didn't get treated in a concrete pipe or a PVC pipe. It just got moved. It's a part of the "away" theory.

TAYLOR: Down the drain.

PETERSON: Down the drain. So New York State has just adopted this new manual, which I would love if we adopted here in Massachusetts. Bits and pieces of it are being used here in Massachusetts, but not as a statewide policy, but it essentially incorporates what many of us have been saying for decades. You can put in little grassy swales. You can slow the flow of the water. The sediment drops out naturally. You don't have to spend so much energy shoveling grit out of the bottom of a concrete catchment basin. So there has been real progress. It's an incredible pleasure to see these things beginning to change throughout the country. On an international basis, I'm afraid we're continuing to export our 1950s technology, and there somehow has to be a leap there amongst the international funding agencies who are working on infrastructure reform in Second- and Third-World countries. We need to bypass our stupid [laughingly] period and use some of these smarter, low-impact technologies, export those as well. We're not quite there yet. But we are beginning to see, though the work of the Coalition for Buzzards Bay, through the upgrades of some of the wastewater systems, we certainly are seeing improvement in water quality in Buzzards Bay--not everywhere. There are always these little places, but we've certainly raised the public awareness that the source of the problem is our own behavior, and that we can fix it. It used to be we just pointed the finger or sent it away, but we're not so likely to do that any longer.

TAYLOR: Do we need a Jacques Cousteau or a Carl Sagan of water to popularize it with the general public?

PETERSON: That's an interesting issue. I mean various people have developed cartoon characters. In fact, the Coalition for Buzzards Bay has one called Cleanwater--"CW." He's a fish. All of us have had a chance to wear the costume at various [laughingly] fundraising events for the Coalition. So that's an attempt to do that sort of thing. The Narragansett Bay Commission down in Rhode Island has sort of a superman in a blue cape and little outfit with a big water drop on his chest, and they've tried to do the same thing. I remain amazed that Americans--and I'll pick on the Cape particularly. Cape residents, Cape taxpayers balk at the idea of managing their wastewater predominantly because of the cost, and yet at the same time, when I first moved to Massachusetts in the 1970s, this item [GESTURES?] didn't exist. You didn't buy bottled water. You could buy distilled water in the grocery store, which, as far as I know, you only used in your steam iron. I have no idea what other people did with it. But, as water quality has declined on the Cape, as nitrates have risen in the well water, the drinking water that's supplied to the residents, bottled water now has its own aisle in every grocery store on the Cape. And people are paying $1 for this, and yet they won't pay to treat their wastewater? I mean there's a circle here. You buy bottled water because you've contaminated your drinking water. Households are spending hundreds and hundreds of dollars a year on bottled-water services. Hey, I don't regret it. These guys have got a great business niche, but they won't spend the same amount of money to clean up their waste and restore their water quality. They will eventually, but they don't get the connection, that the reason we're buying the bottled water is because we've polluted our base. And it's not just the Cape. I mean I know the Cape the best, but it's everywhere.

TAYLOR: Well, the Cape's an excellent microcosm, isn't it?

PETERSON: Well, it's a sole-source aquifer. That's why I pick on it. I mean the pollution that goes in at the top of the Cape affects everyone who lives on the Cape. I don't care whether you're polluting it in Provincetown or Falmouth. It ultimately affects . . . .

TAYLOR: Plus you have all that seawater pressing in against it.

PETERSON: Right.

TAYLOR: You get unbalanced forces here; you're going to have a problem.

PETERSON: That's right. So there's a wonderful opportunity for doing water and wastewater policy, public speaking, consciousness raising. I don't know what you want to call it, but it boils down to really it's a shift in culture. Things that we didn't used to talk about, technologies that used to be considered "ecofreak" sort of things are now becoming commonplace.

TAYLOR: Crunchy muffin.

PETERSON: Crunchy-muffin issues, exactly, tree huggers. We're beginning to show that these ecologically engineered alternatives make good biogeochemical sense and good financial sense, and that's really a lot of what I do now, and I have a great time. I mean we've done little systems. We did a little system for the Franklin Park Zoo, treating giraffe waste. [They laugh.] That was fun. We've done work with various communities in Massachusetts and elsewhere on wastewater treatment. We're just now working with the Bronx Zoo to manage animal-waste runoff and stormwater runoff using ecological systems. So there's a lot of interesting, intriguing work out there. I'm interested in using public places for developing these technologies, because you can integrate it into their exhibit. I tried to get a job at the zoo in Seattle, because I thought it'd be great to have one of the exhibits be the wastewater-treatment unit, where you would take a drop of water and run it through a microscope that you could then show up on the wall--the way they do at MBL when they're doing classes, and you could actually show people the animals in the wastewater, and they'd just be the smallest animals in the zoo. But you could explain that each of those actors had a function in wastewater treatment, each of the bacteria.

TAYLOR: You certainly haven't lost any of your enthusiasm over the years.

PETERSON: [Laughs.] No, but now it's about sewage. [They laugh.] Not just sewage--wetlands in general.

TAYLOR: But I think that's great.

VOICE: I'm going to stop this tape.

PETERSON: I think we're probably done, aren't . . . ? [Tape stops and starts again.]

VOICE: OK, I'm rolling now.

TAYLOR: Well, as we were switching tape, I was commenting on your enthusiasm for what you do, and this is what you're going to continue to do from now on? This is where you're going.

PETERSON: [Laughs.] That and farm until the money runs out. [They laugh.]

TAYLOR: Let me ask you a question. Going back to Woods Hole a little bit. You've been away from it for a few years now. If tomorrow you became director, would you make any changes in the Institution?

PETERSON: Well, I'd have to think of something good to do with Bob Gagosian. [They laugh.] He'd mind if I became director tomorrow. I don't know the Institution as well as I did in the 1980s, 20 years ago. It's been nearly 20 years since I left. I think what I would do is what Bob has been doing, and that is to begin a very aggressive program to raise an endowment for pure research for getting basic science done. Over the decades, the 30 years since I first came here, getting money to do research has become more and more difficult. Because the Oceanographic doesn't get tuition from students the way most universities do, the faculty here--the scientific faculty--have to raise all of their money through various grants and contracts, and that's just gotten much, much more difficult. I'm very sympathetic to that. I've said there are ups and downs in things. Types of science become popular. Then they fade from popularity and things come back. You have to be very agile to be a member of the scientific community here. You have to be looking ahead to guess what's going to be popular and still is within your realm of expertise so you're likely to be able to be funded to do it. The competition with university systems, with other research institutions, is enormous, and I think, in order to maintain the Oceanographic's premier position, it's going to take a hefty dose of private money that allows for innovation, allows for a scientist to look at some techniques or issues that may not be popular within the funding circles or may not even be doable because of other political issues or whatever. But I think there has to be a way to help the very knowledgeable and able scientific staff bridge those gaps. It's particularly challenging for young scientists who come here with new Ph.D.s and a lot of enthusiasm to find enough money to put it all together. It's expensive to do research, and, while the federal government funding has been stable, the competition has grown. And so the Oceanographic's piece of the pie is smaller. So I think that some of this has been addressed with private funding raising efforts for an endowment. Some of it's been addressed by the Institution becoming slightly more applied. I think one of the things that I would do would be to look at some business partnerships where technology developed might be moved more quickly into the marketplace. There're some great opportunities to work with industry in Massachusetts. The McLean Building, after which . . . . Noel McLean was with EDO Corporation, and he was very interested in technology transfer and I think it was why he

was here as a member of the board of directors. So it's now a new issue. It's just more of how to do it. The agility issue for the scientific staff is one that I would work to address. I must say I would also move things along a little faster in terms of gender and racial equity within the place. It's not exactly hospitable for women even yet, and certainly for minorities.

TAYLOR: That was going to be my next question. You told me when you first came here that you and another female scientist were always invited to things at the president's house, but you were invited with the faculty, institution wives rather than the scientists. Has that changed significantly? I mean you did end up a president of a corporation though. [They laugh.]

PETERSON: That's right. I don't know if it's changed. I don't know very many of the women on the scientific staff. I mostly know the men on the scientific staff, because that's mostly what there are. So I don't know how much it's changed. I would imagine it has.

TAYLOR: But it's an issue you would address if you were director.

PETERSON: Yeah, it's been addressed at the graduate-student level. I think if you look at the joint MIT-Woods Hole Education Program, it's done an excellent job in attracting and keeping and producing women Ph.D.s who have gone on to do very interesting things, but if you look at the population of tenured women scientists at the Institution, it's still pretty small compared to the population in other universities, where they've had more aggressive programs. You can't hire women if they're not out there, so part of the Education Program was designed to generate women professionals, so we've done that, but we need to keep doing it, and it we need to keep attracting women professionals to the Institution. But, as I said, it's very difficult because of the funding, because of the aggressiveness that young scientists have to have just to keep his lab, or her lab, funded. It's a tough row to hoe.

TAYLOR: Um-hum. What kind of things do you read?

PETERSON: Oh, I read all kinds of things. I just finished reading Kay Graham's autobiography, which was wonderful. She was the first woman to head a Fortune 500 Company, the Washington *Post*, and her biography was just delightful. It talked about the fumblings and bumblings and bad luck and good luck that got her to where she was, and of course she became famous during Watergate, which is of course something that many of us remember with fondness. [Laughs.] I read a lot of fiction. I just have read *The Ladies No. 1 Detective Agency* [*The No. 1 Ladies' Detective Agency*], which is a mystery story set in Botswana, by a fellow named Smith. It's just a glorious, glorious book. So I read biography. I read fiction. I read a lot

of technical literature. I belong to a number of professional associations, and all those journals come in, and I at least try and read the abstracts. I read cooking magazines. I love to cook. We grow all of our own food. And read the newspapers. I read just . . . .

TAYLOR: You don't know how often I pull a total blank when I ask that question.

PETERSON: About what you're reading?

TAYLOR: Yeah, because there are people that only read the scientific publications. They do nothing beside that.

PETERSON: Well, that can get boring. [Laughs.]

TAYLOR: I ask that because my wife is a school librarian. She always likes to know what the people in the field are reading.

PETERSON: Well, when I was hiring people for Ecological Engineering, I always asked them what they were reading. I wanted to know who they were outside of . . . . Could they keep the books or could they run a wastewater treatment plant?

TAYLOR: Is there anything you thought I was going to ask you, but I didn't?

PETERSON: I barely gave you time to ask much. I talk right on without much . . .

TAYLOR: [Laughs.]

PETERSON: [Laughs.] . . . need for prodding. So [laughs], I don't think so. I think the Institution's an interesting place, always in transition.

TAYLOR: As is yourself.

PETERSON: Yeah, so we all . . . you're supposed to keep moving.

TAYLOR: Well, good enough. Thank you very much. This has been . . .

PETERSON: You're welcome.

TAYLOR: . . . very interesting.

PETERSON: I enjoyed it.

TAYLOR: OK. Good show. Man, you've got more initiative. I wish I had your . . . .

PETERSON: Now we go away with these $400 microphones. [They laugh.] Need to . . . .

[Tape stops and starts again, repeats lines 733-end from 2nd tape.]

[END OF TAPE 3]