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Richard Duncan

"The ORE Plan: a practical application of the systems approach to solid waste management in Oregon"

February 28, 1975

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RICHARD DUNCAN: There's both a happy side to me today, and a sad side, and I want to convey both feelings to you in the next few minutes. Engineers have the most terrible time with microphones. As part of truth in packaging, I'd like to correct an error in the brochure. It reads in there I am an advisor to the Department of Environmental Quality. That should read "Advisor to the Oregon State Commission on Solid Waste." Okay. I feel better now.

This week we're focusing on "Vital Partners," the association of the city and the university, and how we can work together. We as... those of us at Portland State University can act as advisors, act as scientists, specialists, generalists, upon request from people from the outside. We can act at the state level, at the county level, at the city level, at the citizen level: all up and down, we can lend whatever support and aid we might. In turn, the city can come to the university, as opposed to university people going to the city. One way we can do that is as you're doing right now, in this Vital Partners week and the S & W lectureship seminars. Other ways you can do it, as agency people, as citizens, you can call us and ask for our help, advice, consolation, sympathy, whatever you feel you might need.

Now, the title of these S & H—I keep forgetting whether it's S & H or S & W? H. ...seminars is "managing complexity." And I want to suggest to you that there is the possibility that we cannot manage many large, complex systems. Possibly, we can manage some, but I think it's very presumptuous to think that we can build many different types of very large, complex

systems involving man, nature, technology, and can manage them in a rational, reasonable way to avoid certain undesirable circumstances such as the collapse modes discussed by Professor Holling yesterday. What I want to suggest is that possibly one of the most scarce resources in our world today—in Portland, Oregon, too—is the ability to manage, to control or guide complex systems. Information and action... information, decision, and action is itself a resource, and lack of ability to do this means that we might not be able to manage or guide the systems that we have built.

We're not at a loss, however, for alternatives. One alternative—one of many—is that we can reduce the size and complexity of our systems so that they become manageable. So that then the resources we have available to manage them will work. I'll speak of such things as decoupling society, as local self-reliance, as people solving people problems. I feel very strongly that many solutions to the problems that we have—the issues, describe them as you will—many of the solutions will lie on the community, neighborhood, and personal level, and we can expect precious little help and few solutions, whether they be from city hall, from Salem, Washington D.C., the United Nations, or heaven.

Harold Linstone mentioned the marriage of theory and applications in the systems approach. Both aspects of the systems approach are very important. One cannot do without the other. It might work—I'm mainly an applications person—but I borrow and use theory every day, and I've borrowed and used theories, ideas, concepts from virtually all of the speakers that you've heard, and the ones that you've yet to hear as well. This includes: hierarchy theory, the structure of systems in a top-to-bottom fashion; it includes systems control, the idea of stability, instability; the concepts and theories from behavioral science, including those of Maslow, Piaget, Skinner. I use them all, it's not an either-or thing. I don't either push Skinner or Maslow or Piaget, I try to blend them, because I think people are too complex to fit into any one mold.

Cybernetics has been very useful. Cybernetics and communication, as Doctor Bellman so eloquently spoke of. Communication is far more than words, pictures, people talking to computers via computer languages, and computers talking back to people. Communication involves some sensory perceptions, some body language, some things that I can't even guess at. For instance, many of you have been in... you've been viewing my appearance, and many of you have already decided how we're going to communicate in the next 40 minutes. Maybe you don't like my tie, or maybe you like it; maybe you don't like how I hold the microphone, or maybe you do like it. And the words that I'm saying are only secondary to whatever other body languages or extralinguistic communications that've taken place. We've already decided whether we're going to play with each other or not in the next thirty minutes. The methodology

and tools of systems are very important. Doctor Bellman mentioned dynamic programming, it's extremely useful in some systems at work. The theoretical concepts of entropy are very important. Entropy is a measure of disorder, and essentially what this law says is things tend to wear down, they tend to wear out, they tend to break: people, organisms, buildings, cars.

Now, in the area of applications, I would like to suggest that the important applications are discernable by viewing the importance that society gives to these processes or systems. If you can detect large energy flows and resource flows, you have then identified a system that society recognizes as important, and I suggest that systems people should seek these areas in their applications. In theory, you don't have this comfortable measure. I know no way in which a theorist can predetermine the area in which he or she should work, because good theory comes out of the most unexpected places.

The areas of emphasis for applications that I will suggest are food, including the way we do it in America—agribusiness, food processing and distribution systems—I suspect profound changes in these areas in the next decade, and I think systems people and lots of other people—and we're all systems people at heart, we have to be—can play a significant role in redirecting these systems and processes, and making things work better. Housing is another area, do more with less; land use; population, both on the global scale and regional scale and local scale; education systems are extremely important. We've tended toward centralized education in the United States, costing a lot of money, not only for Portland State University, but for our high schools and elementary schools. My suspicion is that we can do a lot better education, more fun education, and experience a better learning environment for a lot less money. I'm going to suggest true neighborhood schools, whether they be storefront, basement, or whatever. Instead of three to five hundred students in an elementary school, why not 30 to 50? Recycling of materials and resource conservation: I think is an obvious area. Religion is an area we should look at in a very open and honest sense. What does our religion mean to us? Whether it's any of the orthodox religions or the other religions, or whether it's humanism or atheism or existentialism or nihilism—these are all religions—and everybody, developed believer, militant atheist, is religious. Religions ask the important questions. Often they give the wrong answers, in my opinion, but who am I, where did I come from, how do I relate to nature, how do I relate to others, how should I live my life, what is good and what is evil? And religion, indeed, should not be an abstraction, it should be a part of our life. Health maintenance is a very important area of application, as contrasted with medical care—again, it's not an either-or situation, we need both. Health maintenance is keeping people healthy. If you're healthy, how do you stay that way? Medical care is if you're sick, how do you get well? I suggest we could get... I suggest that if our resources were more directed toward health maintenance, like good food, proper food, the right amount of it, exercise, a good psychological environment, caring, sharing, joy,

that a lot less of the patch-up stuff would be necessary... environmental concerns, and we could go on an on with areas of applications.

Okay. I would like to suggest this, and the hope is that I will not alienate any theorists. Please, I don't mean to do that. But I think we have to avoid what I call Aristotelian fantasizing. And, briefly, by that I mean it is possible for a theoretician to sit in an ivory tower, whether in academia, or in a think tank, or in a city agency, or state agency or wherever else, a business, and make some logical conclusions about the real world that are absolutely false. There's no ground truth at all to what they believe to be true. One of the reasons that these fantasies are believed among professionals—I describe them unkindly as professional ignoramuses at times—is because their ground truths are their colleagues with whom they exchange memos, notes, comments, and statements. I call it Aristotelian fantasizing, because Aristotle, as we know, a few thousand years ago, sat in his ivory tower and through a logical deductive reasoning, hypothesized that big rocks fall faster than small rocks. And, for several thousand years, people believed this simply because they did not bother to go out and drop a couple of rocks off a cliff, or a tower, or whatever. Eventually, Galileo did, and devastated this fantasy that had stood for several thousand years.

There are many, many other cases of this, and people that really should know better, you know, well-meaning and brilliant and accomplished people. Let me give two more examples. One, a statement by Jacob Bronowski—and Dr. Bronowski, a brilliant mathematician and theorist, I think a very confident applications person, I'm simply not so familiar with that side of his work—made a statement that human beings are the only animals capable of generalizing symbols, generalizing language. Now, those of you that are familiar with the work being done by the gardeners at Arizona State University, where they are teaching ASL, American Sign Language, to chimpanzees—"baby," "drink," "cup," "me"—these are standard ASL sign symbols. Know that for instance when a chimpanzee named Washoe, who had learned many of these language symbols, over 200 of them, found that they had put a little baby doll in her cup, she said "Baby... in..." [drawing signs on chalkboard] "baby in my drink," and she had not put these symbols together in that fashion before, which would have... what I would have expected her to say is "baby in my cup," but she has indeed generalized the concept "drink."

A last example I'll get is from a delightful, very brief paper by Dr. Mariama of our systems science program on exogenous expertise in the *Futurist*, October 1974, and he gives many illustrations of where exogenous, that is, outside experts, have gone wrong in their theorizing. One of the illustrations I remember that you gave, [...] is that it is common for people from white, middle-class backgrounds to assume that ghetto children fight because of peer pressure,

when indeed, if we go out into the real world, we find that they fight for survival. Is that reasonably accurate? Okay.

Now, we're going to turn to recycling and solid waste management. This is a specific application of the systems approach, it is not the only one. I don't claim there are not better solutions, I don't claim this will be a permanent solution... what I would like to say is that it's an alternative to other ways that recycling might be accomplished; that it should be explored in some detail. It should be experimented with in the field to find out: does indeed it offer a viable alternative? There are a couple papers available on it, one is on the experiment—what I call an intrasystem experiment, an intrasystem model—the Sunflower Recycling organization in Northeast Portland, where we built a model, and through evolutionary testing, tried it out in the real world. The other paper describes the ORE plan more explicitly, and they're available from our department.

Now, before I launch into the ORE plan in the slides that you'll look at in the next few minutes, I feel that it's about time for me to recycle myself. I've worked on the recycling and solid waste management now for 15 months, and for sev... intensively, and for several years before that, more or less informally. And, like all of us, we become exhausted in ideas, patience, and energy. There is a good time to say, well, I've done my best, I'll stay aboard, but we have to... each of us has to seek new areas of work where ideas are fresh and new and where we have new vigor. I regard the ORE plan, the Oregon Plan for Recycling Household Solid Waste, as a lifeboat for society, as an arc, or what I like to call a mutant social chromosome. It's a new idea; it's somewhat radical and different indeed, mutants are radical. In general, mutants are fatal, so I won't demand that this approach be viable, I won't demand that it works, I just expect that during changing times, that the environment will test it and see if it works. If it works, fine, if it doesn't, I can live with that.

Several businesses have been established using this alternative approach to recycling and solid waste management. This makes me feel that the baby, my baby, our baby, has gone beyond the gestation period, and has now been born, and I guess it will have to be nourished by society if it's going to make it. I've done my bottle feeding. I'll continue with some help, but it has to eventually make it on its own. In addition, in the Portland area, four of these businesses are in the process of starting up, and throughout the country, I have word that several others are either working or are in the planning stage. I received a call from... one of the things in making systems work, you have to find the people, the institutions that will help you out. You have to find the power flows, the control points, and you have to turn those on. Very, very important. You cannot do implementation without power flow, without resources, without people, without energy. I received a call from the vice president of Allsport Corporation on Monday this

week that they would like to send us two small vehicles for application and testing here in Oregon.

Before we go into the ORE plan itself, like to read a letter. This is why I feel I am ready to go into semi-retirement, on recycling and solid waste management, this is about as far as I can push it; I'm running out of energy, getting worn out. They handed me a cane downstairs in audio-visual, I think I'll use it for more than pointing to the slides. This letter from Mark Hatfield to Russell Train reads: "I would appreciate it if your office of solid waste management..." Russell Train is the administrator of the Environmental Protection Agency in Washington D.C. "...if your office of solid waste program would review this article..." the paper on the ORE plan approach, "...and the program carefully and seriously, and provide me with a detailed analysis, particularly concerning the feasibility of adopting such a plan on a nationwide scale. I'm also interested in the possibilities of research funding for this project." I am, too.

Okay. Let's look at some pictures. Could we have the power, there, 'round back? We'll talk a little bit about the systems approach, and then move right on into the ORE plan. Garbage. It did used to be called just "garbage"; now we call it a valuable urban resource. I would like to suggest—and the first few slides deal more with systems than with recycling per se—that we modify the graphics relating humans, society, technology, and nature to show nature as an entire underpinning of all these systems. Even if we manufacture toothpicks, there is a natural underlay. The toothpick itself is a product of plant growth. And the systems that we are primarily faced with, as Dr. Holling said, the systems that are least well-known and most troublesome are those where the three areas intersect here. These are the toughies.

And now, I cannot pronounce his name, you can read it, he won a couple Nobel Prizes, but he stated—Albert von Szent-Györgyi, that's as close as I can come—"Naturally, the higher we climb on the ladder of organization and complexity, the less our material becomes accessible to mathematical analysis. But we must not think ourselves to be scientists only when speaking in equations." Equations work very well up in this domain of technology. We can get people to the moon. When it comes down to any of these other areas, things become much more complex. When humans' value systems and a whole lot of fuzzy stuff, and a whole lot of unknowns, and possibly unknowables, enter into the systems behavior.

I'm going to suggest that there have been three recent watersheds in the area of ecology and resources, and also with respect to systems science. The first watershed was Earth Day 1970, when we went from a mindset of exploitation to one of stewardship. It's no coincidence, I think, that also we... I will put the watershed for times of abundance to times of scarcity, at precisely November 1970. The reason being, November 1970, that is when the United States

ceased to be... well, that's when the production of domestic fossil fuels started their decline, and it's declined ever since. I will suggest that the work to be done in the systems approach went from theory to applications about that same time. During the time of abundance, we can support a whole lot of people doing theory, and then when things become more scarce, resources, money, become more tight, the focus will then switch toward applications. I'll just point out that in Pakistan, India, and Bangladesh, there are not a great number of theorists, and the reason I think is clear.

Okay. The quantitative tools that have come in to help us work in the era of cultural natural systems have had some... have given us some very good support and help, but it turns out that the qualitatives that cannot be handled by engineering and economics and business are equally important, and even more important in most cases than the quantitative. So, I'm suggesting that probably the most amount of help can come from these areas: from the concepts, theories, the understanding we can glean in these areas, and that matters such as beauty, love, trust, friendship, et cetera, will be crucial and important in helping us better make our world and systems work.

Doing real systems: one, learn how the world works. Two, find the important problems that we've already talked about, identify them. Learn the problem. Get the facts. Explore and formulate alternative approaches. Find the control points: very, very important. Don't try to make a change, a modification in a system without knowing how that system is controlled. Make a friends and foes list, know who your friends are, get 'em working for you. Know who your foes are, and try to bring them over to your side, or avoid being crushed by them, but definitely identify them. And, celebrate the birthday of the new approach, and again, recycle yourself into a new area. There have been some institutional barriers to accomplishing recycling. I'll just mention the present collectors, the bottle manufacturers, the hardware manufacturers, the universities, and many of the people in the EPA have not been our friends, and we either have to confront them, or avoid them, or try to bring them over to our side. A friends list I think will be obvious.

We've recognized that our system is in a rapid state of flux. Unemployment is one area, a very obvious metric; this was back in July. Unemployment, on the national level, is up here now, and in Oregon it's somewhat higher. I maintain that unemployment is going to be one of those very serious societal problems, probably within the next ten or fifteen years.

And, we're going to seek different ways of doing things, and I'll use the term intermediate solve, alternative, simple, general, self-help, democratic peoples, mature, appropriate, whatever... technology to describe some of these solutions. And the characteristics are given on

the right hand side. The local, small, decentralized, efficient, durable, repairable. People do matter with this new technology, and they are nonviolent.

Recycling. Very quickly, we're going to look at the way the world works, some definitions. The present system, secondary materials industry, we will not look at that at all, the so-called MSD action plan, the big machine approach, and finally the ORE plan. That's how the world works, a la Ian McHarg. Energy flows through the system, and materials recycle in any natural ecosystem. That's the way it works. In a man-dominated system, we... energy flows through, and we tend to put our valuable resources in the garbage dump. There are many kinds of waste, we are going to focus on household solid waste. That's a major area of focus. We're not looking at all waste; household solid waste primarily.

Order versus disorder. This relates to the concept of entropy. A bottle, a chunk of glass that's in the shape of a bottle is usable and valuable to mankind. If you break it, it's not so valuable, and that's a qualitative difference. It's not a quantitative difference. There's the same amount of mass on one side as on the other. Same amount of energy on one side as the other. Difference in quality. Order can be represented when materials are separated by type. They are useful to us, economically; and when they're thrown together in the garbage heap, far less useful, and a huge amount of information, decision-making, and processing have to be applied to get them back into usable form. This is a concept of home grouping of materials, something that was done during World War 2. This is the way we do it in our household, and this is the way we asked that... the way the recyclers in Northeast Portland asked their households to do it, into six categories. Another one of our recycling teams separates into only four categories.

Now, this is an example of Aristotelian fantasizing. The MSD consulting engineers stated this: "The concept of total home separation was found to be infeasible both socially and economically, and was also rejected." They had absolutely no data, no real world experience to base this fantasy on, and we disproved it in an experiment this last summer. Indeed, people will separate. Representative Paul Hanneman has a contrasting opinion as stated in the bottom: "Home separation is a key," he says. The present system: we collect home mixed waste, haul it to a landfill, and throw it away. Here's where it starts, when the household, it throws its stuff away. That's my thumb on the lower left, and our six-year-old daughter. We don't put anything in the garbage can at our—that was a setup—we don't throw anything away. Oh, a little, but, okay. Collection of garbage is 80% of the total cost of your garbage bill. 80%. Disposal is only 20%.

Now, the MSD action plan, the [...] engineers *excluded* collection from their study in solid waste management. Excluded. We emphasize in the systems approach, you should put in all

important variables. Now, I think it's patently false to exclude collection. It should be clear. Here's a collector... Seattle is quite different from Portland, incidentally. Seattle has municipally franchised collectors, and Portland has mostly private collectors. Here's a father-son combination, a private businessman; hauling rights are virtually socially hereditary in garbage collection. Father to son, father to son, father to son. Here's a large truck, costing 25 to 30,000 dollars, gets four miles to the gallon. Here's a larger truck yet, costing 37,000 dollars, and the current price is over 40,000 dollars, gets three miles to the gallon. I think you can see that these big trucks are a thing of the past. Doesn't that remind you of a dinosaur? More rolling stock. Take a good look, because you won't see 'em forever and ever. Part of our path... there's another way to do collection using smaller vehicles, and there's another way to do collection yet, hand push carts is an alternative. The engineering department at Portland State University just finished this up, a beautiful hand push cart. Maybe some of you saw it at the engineering open house, and this is an example of the Vital Partners: the university, in this case, doing something that will be actually tried in the city. Built by Professor Dan [...] and his class. This is another approach. This is the dropoff approach, in which people bring their stuff to recycling centers. I don't think this'll wash in the long run. It's energy inefficient for each person to bring their recyclables to a dropoff center, and besides it has not been successful in significantly pulling our resources out of the solid waste stream. Most everything has still been landfilled.

The MSD action plan: this is the big machine approach, the grandiose engineering solution, big centralized, energy intensive, capital intensive approach. They want to collect home mixed waste, haul it in by one set of trucks to transfer stations, there shred it by a giant garbage eater, chew it all up, recover some of the materials by big machines, and then either by a second set of trucks, take the stuff to landfill or to markets, and then throw away what's left. The big machine approach. Last year the cost of this system was 15 million dollars. What do you think it is this year? 41 million dollars. Increase of over 150% in 12 months. In the same period of time, real wages has actually declined. What does this tell you about the economics of the future? It's suggesting employment intensive approaches, rather than capital intensive approaches. Oh, did we miss one? Oh well, this is the stupid systems of... excuse me. This is the... well, yeah, I meant that, it was more than a Freudian slip. I meant it. I think it's very a narrow-minded thing to only look at disposal. It limits your options to one. You've got this mountain of heterogeneous mixed garbage, what can you do? You can hire a million pixies to pull out the good stuff, or you can try to stuff it through a big machine and chew it up and pull it apart. Your options are closed once you've said, "We'll only look at throwing it away." A big machine approach is a surety. This is just the big machine system, this one is working in Portland, and it costs about a million bucks. They want to put in... well, originally they wanted to spend that whole 41 million dollars on systems of this sort.

This is another picture of that same system, this is the air separator. I won't describe it, it's very uninteresting, unimaginative. Most of the engineers... many of the engineers who have worked on this are right out of the aerospace industry. I think their aerospace mental... I'm an ex-aerospace engineer, so I can malign them and get away with it. Much of their solutions to urban problems have had a strong complement of aerospace hardware, big centralized systems approach.

Order and the action plan. The materials at the household level are mixed by the householder, the order decreases; they are shredded and further mixed, and then it requires 41 million dollars of processing equipment and energy to try to—and a lot of energy—to try to get out the good stuff. I claim that's not the way to fly.

Professor Hannon's rule is: recycling a mass should be accomplished at the earliest opportunity in order to use the least mass and the least energy of the alternatives available to perform the desired service. The meaning of this is that material should never be mixed in the first place, if resource recovery is the goal. That's the key. It's a behavioral thing. In other words, the engineers—I shouldn't use this term in such a pejorative sense—there are a lot of good engineers. You've got Dan S[...] and... chairman Ken Young of the engineering dep... very fine people in this room, who have been very helpful and very coop... we need more like that. Okay? All right.

The ORE plan. We'll consider a lot of other variables. How do you manufacture goods, make 'em more durable, more repairable, look at collection, householders' behavior, look at unemployment trends, shortages... if you consider all of these things, I claim, it will direct you toward a best solution as a low cost and employment intensive solution. The ORE plan, ahh. This is a very heart-rendering... this is maybe the last time I'm going to make this presentation. And since I've given it 99 zillion times, yeah, this does something to me. Okay. All right. The ORE plan: we collect home grouped waste. Not home separated waste, home grouped, grouped by type. We haul by—replace this, these were done last July—we haul by light-draft vehicles; they might be Cushman vehicles getting 60 miles to the gallon or something like that, they might be push carts, they might be pedal carts, whatever, to the neighborhood recycling center. Now, it's a neighborhood operation, neighborhood-centered, neighborhood employment, it's local people solving local problems. Aggregate and store the materials there and then haul by trucks, and now we'll use the big trucks, we use them where it's appropriate, to haul materials either to markets or to landfill.

Speed up with the last few, here. The key features are home-grouping, incentives for the householders; our charge is \$2.50 a month, versus about \$5 for the average householder in Portland. We have... it's neighborhood centers, we do provide collection service, it's, again, employment-intensive. Some, a lot of people didn't like "labor-intensive," apparently labor is a bad word, but we must provide regularly scheduled and reliable collection. We must take everything, including plastic and organics and we do, we even take things that collectors don't take. We take branches, and we take tires, and we take... you name it, we'll take it, okay? We've got to pay all workers, the day of volunteerism is over in recycling. And finally, the organizations must be self-supported. They simply cannot function on grants and gifts forever and ever. What we do is organize our neighborhoods with a neighborhood recycling center, close to the center. Then we organize our city and the community recycling, use NIUs and CRUs. The NIUs pick up the materials from the households and aggregate them, the CRUs are essentially brokers of transportation. They pick up the materials and take them to the secondary materials market. It's an organizational structure.

Sunflower Recycling, our working model, I call this an intrasystem model. I've tried mathematical modelling, and got very little direct results. But, intrasystem modelling. Doing things, actually, in the real world. Building a mathematical model isn't very convincing to people. Changing something in the real world, doing something in a different way and then bringing them out to show them how you do it is very, very convincing. This is getting results, we're still pushing the mathematics and we'll use it if we can turn the trick, but I like this approach. Here's a recycler taking organics, in this case, from a householder, gathering data, working with householders, picking up materials, going back to Sunflower with our cart, composting our materials. Okay.

This is what the MSD theorizers said could not be done. People would not home group. I hope you include this in your next paper, Dr. Mariama. [laughs] We started an experimental area of 250 households in December 1973, and we asked them to home group their materials, and we would collect. And, we attained, in 10 months, almost over 50% cooperation, it's still on the increase. They said it couldn't be done, they said people wouldn't do it, and that's a lie, people will do it. People are not diabolical, if people know what to do and how to do it, they will cooperate. I'm often a pessimist, but I'm really very optimistic about the potential for people solving people problems. The potential is very high. If we pull it off or not, I don't know. [dramatically] Okay. Our NRUs have four people and peddle carts and small-engine vehicles. I mentioned that we are using three wheel, small-engine vehicles, now, at Sunflower. And the community recycling units have six people and four trucks. Oh, we'll make a lot of jobs. I don't believe the numbers in my paper, and if you read it, don't believe me either. It's just the best I

can do, at first cut. But, it'll make a lot of jobs; in the Portland area, about 3,000 jobs will be the net result.

This is our budget picture here. And, what I maintain is that collection of recyclable materials, home-grouped recyclable materials, for a fee—let me emphasize that, *for a fee*—we're not doing it free. It replaces the present garbage service, is not supplementary to it. We'll provide the major financial base for doing things this way. The major base. The sale of secondary materials is highly erratic. Paper was \$40 a ton last August, what do you think it is now? You can't give it away. You cannot build a business on an economic base that fluctuates like that. The rent goes on, month after month. And we can do certain services. So our primary source of income is collection for a fee, and this is a budget picture of that that I hope is reasonably accurate. Professor Hannon did this work to show materials come from a natural biosphere, and eventually they end up back in our biosphere, geosphere. Why do they end up back? Irrevocably, why? The workings of the entropy law. Sorry; eventually things wear out no matter how careful we are. But, we can maintain them in this dotted box in this cultural natural system for long periods of time; that's called recycling. The Oregon bottle bill is rewashing and reusing bottles here, that's the best way to go. Reuse things. If you have an old shirt, give it to a friend. Okay? If you got a bottle, why don't you wash it and use it?

Our ORE plan approach does this, and does this. The big machine approach gets things out in what I call the entropy trap, and then uses 41 million dollars to get out some of the good stuff. Not a very smart way to go, it's definitely a very costly way to go. And, the ORE plan, in order: the householder separates the waste, and then we aggregate them to the neighborhood recycling center, and they go right to market. No big machine has to intervene. Isn't that neat? Does that turn you on? That's people doing things differently to solve people problems. Okay? And this puts both of them together. The material starts here, the big machines go this way, the low road to disaster, they get in the entropy trap, and then they have to use the big machines to pull out the good materials and we go this way. Our materials are more pure than theirs; even the best machines don't work very well. Engineers are working on it, if they pull it off; no one knows what the future brings. If we develop fusion power and the fusion torch, the big machine might work someday. I'm not against it, but we've gotta get over the next ten to twenty years in the meantime.

There are a lot of good things that happen if we do things the ORE plan way: make a lot of jobs, we reduce garbage bills, we attain a high degree of recycling. Even if the big centralized system works, it will never accomplish this, develop a sense of thermodynamic or resource thrift. Never, absolute never. It make... when they plug in the big machine, they instantly make everybody a recycler. No sensitivity results from that. Does it? I don't think so. It'll enhance the

sense of community and neighborliness and give people confidence in solving their own problems, and educate recyclers to conserve energy. I have estimated that it will save 1.21 billion gallons of gasoline annually on collection alone if the ORE plan is implemented nationally, and make nationally 310,000 jobs. Okay, some people are going to lose jobs: the present collectors, if they don't switch over or don't find new jobs or something else, yeah. Any change in a system is going to be uncomfortable for some people. Some people are going to benefit, and some people are going to lose, and anybody that's working in systems and going to try to change things must recognize it. And we can't be callous that these people are going to lose jobs, they've got kids in college and you know, they've put 25,000 dollars invested in a truck. We've got to try to include them as best we can. This is the way the world should work. We should close that loop. And, my girls helped answer the question how we should change the world. The answer: little by little. I have three girls, and the third one did this. You'll have to interpret it. The writing reads: "Running makes your life strange." Let's all run. Thank you.

[applause]

HOST: Thank you very much, Rich, for a delightful discussion, and I think some very valuable lessons. We are open for questions. Please use the microphone.

QUESTION 1: Duncan, Dr. Duncan? Yeah, since the last time I saw your presentation, a couple of questions have come up. Yeah, first, I'm glad to note that you've gone to three-wheeled power vehicles rather than people pushing carts around...

DUNCAN: That's intermediate, gentle technology. That's not a cop-out. We're still pushing carts. Close to the recycle unit, we use the carts.

QUESTION 1: Okay. On a grid system, in an established neighborhood, I assume you're working on something that's about a 20-block grid.

DUNCAN: Something like that, yes.

QUESTION 1: Yeah, that's the figure I remember. Okay, now, in an area like Hollywood or Laurelhurst or even in the West Hills, that means that in order to establish a center, you're going to have to take out one or more housing units, demolish those, build a recycling center, then you're going to have to relocate the family involved... now, since I came in late, so I don't know whether you dealt with that problem today or not...

DUNCAN: Okay, we've dealt with that in the real world, and it's not true that you have to do that. One of our two recyclers are working different. The two recyclers that are working are Sunflower Recycling and Fisher and Everett Recycling. Sunflower Recycling does have a neighborhood center, a big warehouse in a community, it's actually in a business area. The other recycler does things quite differently. It has a van truck, a big truck, and it drives that out into the neighborhood, and then the little three-wheeled vehicle goes around and picks things up, and it has a mobile recycling unit. So we do not have to have a recycling center in a neighborhood in order to service and home collect from that neighborhood.

QUESTION 1: Okay, fine.

DUNCAN: Okay. Thanks very much for your comment. And the only way we could've found that is to go out in the real world, because my conclusions were the same as yours: we're gonna have to either find old gas stations or build something, and we don't have to do that, we found other ways of doing. It's amazing, by going into the real world and actually doing things what you learn. [...], you had a question.

QUESTION 2: This was a very interesting presentation. I'm glad that this is not a blue-sky idea, that's what you said in the summary, it's a grey-sky idea, you know, very appropriate for Portland. I have a very simple question. I have a... I'm just saving up jars and bottles and what I do, where do I bring them? Does anybody come and collect them, or... ? I have lots of them.

DUNCAN: You have a lot of bottles.

QUESTION 2: Yeah, jars and bottles and nobody knows what to do with it.

DUNCAN: Wonderful! Where do you live?

QUESTION 2: One of those [...] in that... something that Portland people are very proud of, the thing called Portland Center, and nothing works there, really...

DUNCAN: Okay. We have three recycling ORE plan businesses starting up in Southeast Portland, we have two running up in Northeast Portland, and one due to start up in Northwest Portland. We haven't yet approached your neighborhood. Now, one thing that we're asking the Environmental Protection Agency for—and we're not against taking a little bucks to try some new problems—is for working an apartment, and we would like to try the ORE plan in an apartment or high-rise structure or whatever, and without building a model in the real world, I cannot even guess at the feasibility or economics of doing this. It's a different system. With

respect to your circumstances, if we could organize something in your building, very possibly we could make your apartment structure a test center for an EPA demonstration, if it comes about. Right now, all I can suggest is that why don't you come into Portland State to work and bring a few bottles and jars with you and drop them off at the Portland recycling team center, which is only two blocks over this way, on Montgomery. That's the only immediate solution I have. Eventually, I hope we're servicing your area.

QUESTION 2: I can think of a place there that has a garbage room downstairs, is it there that everything just comes down the chute. But they don't have those—what you call—groupings down there.

DUNCAN: But isn't it true, though, that we would have to teach people or train them or somehow change their behavior so that if we wanted to get all the bottles at once, and then all the papers at once, they would have to put down the chute... because you've only got one chute, is that right? And everything goes down, so we have a problem. Now, if we could have them first put down all the bottles, and then all the cans, and then all the paper, and then all the food waste, then we could put different catchments underneath, and keep the materials separate. But, I think the behavioral, the social changes in this are difficult in this point. Another change would be to have recyclers go up there and actually collect the materials from outside the doors, and have them, the recyclers themselves, put the materials down the chute.

QUESTION 2: Okay, I think you have some problem because of their locking policies, you know, they have pretty complicated locks and doors and [...] and other kind of things, so one possible way I can think of there is, on each floor there is a garbage chute room, where something could be grouped there, but I think the best place to group would be downstairs, where everything comes down the chute, then that... I guess maybe Dr. [...] can explain, because he lives there, too.

DUNCAN: Okay, sure.

DR. [name unintelligible]: I'm very familiar with the situation, and there's one... seems to be one obvious, very simple, real life solution. Seems to me could be made practical, it's primarily a question of education, that is to use, to put in different days. One day cans, one day paper, and so forth, so that you alternate, so that you have a schedule, and everyone knows on Mondays this kind of stuff, on Tuesdays that kind of stuff, and so on. So that's my idea, it should be, obviously, tried out. I don't... it doesn't seem unreasonable. One thing, one question I would like to ask, if I may, is: Portland has a rather unique situation in terms of having a fee, charge, private collection system. Where I come from, in Southern California, it was municipal, and so

you know, that you had a different situation, and really there's very little incentive, people don't have to pay, write out a check or something, but there isn't the incentive to say, Well, I could even, you know, save some money, instead of paying five dollars a month I can pay, say \$3.50 a month, it looks like it's just part of the tax, and why should I have the trouble. So you need to develop some kind of incentive system. If I remember right, Sam Yorty was elected originally as mayor of Los Angeles on a platform of not separating the garbage of the household, so this issue has come up before.

DUNCAN: Portland, indeed, is unique in this sense. Not many large cities have this private collector arrangement, where the garbage collector himself, or herself, bills the householder. So we have a real world laboratory, a city in which we can try these things. This would have been impossible to try, because of franchises, in Los Angeles or Seattle. I think the way those cities are going to change: they'll see it works here, and they don't need the big machines, or at least it could be an alternative, you could have the big machines running for the people that want to throw their stuff away, and the alternative running for those who wanted to recycle. Have them both going together, let 'em compete, that's the old free enterprise, I believe the term is. I believe you were first.

QUESTION 3: I'm in pretty large sympathy with pretty much everything that you've said, but I'm concerned about one, I guess we could call it an assumption, that you mentioned, which I don't care if we call it Aristotelian or not, [laughs] I guess we all have a little bit of Aristotle in us, but it's sort of the inertia [laughs] of past experience or something like that, limited experience. But anyway, the question I have is a pretty practical one, of the assumption or statement that these operations need to be self-supporting by some criteria, some sort of traditional criterion of making it in the business world or something, and the kind of problem I have is that—I haven't worked out the figures for the specific situation that you've described in terms of the number of households serviced and the number of people employed—but I have the impression that, at least at Sunflower, it at certain stages was making, was not getting very much money to...

DUNCAN: And we're still not, we were entirely volunteer for a long time and we're only starting to pay wages now.

QUESTION 3: Okay, so it seems that given the extreme desirability of an approach like this in terms of various criteria that you've applied, you know, how these things can be supported itself needs to be subjected to the trial of various possibilities, and I can think of a couple of them that have, at this point are just maybe blue-sky, but one of them would be, just as a conceivable possibility other than sort of formal grants issued by big institutions, is something we might describe as investment, not for monetary... voluntary investment by individuals and

local organizations and so on, not for monetary profit, but in some sort of sense of investment in the future community...

DUNCAN: I'm delighted to report that this is being tried in Salem... in Eugene. I met with a lady down there just last night, who has her neighborhood organized on a voluntary basis, six people have volunteered vehicles, 20 people their labor, and they've been running for something like six months now, and it seems to be working, and it's something I claimed, because here I am, doing my own fantasizing.

QUESTION 4: I solved my garbage problem in another way. I do my own canning, and use a neighborhood co-op grocery where I bring my own supplies and fill my own sacks and so forth, and I have remarkably little garbage to recycle using this method. And I'm wondering how much energy is being put into that kind of solution to the whole garbage problem.

DUNCAN: Oh, something that I entirely, I neglected to talk about. What, you know, what can you do in 45 minutes? We've got to emphasize *reducing* the amount of garbage that's generated. We've got to look at more durable... using less, and my opinion is that the quality of life is going to improve as we learn to do with less material things. Now, with respect to people who have very little waste materials, we have all, we have flexible schedules. So, \$2.50 is an average that we charge, we charge for retired and low-income people way down to a dollar a month, and then, okay, so.

QUESTION 4: I think the idea of having a central grocery where things are bought in bulk, you know, and that the homeowner recycles their own containers so that they never have to go out at all.

DUNCAN: Wonderful! You're pointing—when I told you I had to recycle myself, I'm going to read the... the next target, we're taking on Safeway. [laughs] We're going to win that one, too. Not me alone, all of us together. Okay, they're big and tough and growling now, you wait. Yes?

QUESTION 5: Did you say in one of your slides that entropy is not quantitative?

DUNCAN: Would you repeat that please?

QUESTION 5: Did you say in one of your slides that entropy is not quantitative?

DUNCAN: Yes, it's a qualitative measure. I refer you to the book, the entropy process... *The Entropy Law and the Economic Process* by Georgescu-Roegen, and it is quantified, there are

several different expressions for entropy. There is the Carnot expression, there is the Boltzmann expression, there are formulations of information theory, but these are arbitrary descriptions, and you could just as well mathematically describe it by other terms and it would serve just as well. It's really a qualitative difference, and it's...

QUESTION 5: It's a well-defined word, it has meaning in physics, it's a well-defined word. I don't see how you can go about changing... or you can adopt, if you're not using the same words as we're using.

DUNCAN: It's a well-defined word in physics?

QUESTION 5: Certainly.

DUNCAN: Yes, it is! It's calculable, etc.

QUESTION 5: Calculable, quantitative, well-defined, not ambiguous, volume-space based...

DUNCAN: Okay, all I can say is the Carnot definition of the integral dt over t from q_1 to q_2 , is quantitative, but this is quite different than the Boltzmann expression of entropy for information, and one is not derivable from the other...

[both talking at once]

QUESTION 5: Those two different definitions only... are both quantitative, and they only differ by a multiplicative of a constant.

DUNCAN: Okay. Let me refer you to the book I suggested by Georgescu-Roegen, who is himself an eminently qualified mathematician, and he maintains that entropy is indeed a qualitative measure, and descriptor, and not a quantitative descriptor. We have an expert on these matters, Dr. Phil Pennington.

PENNINGTON: [shouting off microphone] I'm sorry, I'm with him.

DUNCAN: Okay.

PENNINGTON: [louder] We're of different opinions.

DUNCAN: You haven't read Roegen's book, yet, though. I agree, there are... why couldn't you define it and end up with the same results as dt over t squared?

PENNINGTON [off microphone and partially inaudible]: No, the information theoretical expression isn't [...] it turns out to be identical, [...]

[PENNINGTON and QUESTION 5 speaking simultaneously, off mic]

QUESTION 5: ...those two definitions for entropy happen to be the same [...] it's really nothing more than a constant...

DUNCAN: Okay. Okay. We accept strength in diversity, don't we? And if we differ in opinion then we're stronger. I'll swim along with Nicholas for a while and we'll all learn from the process. Yes?

QUESTION 6: [inaudible]

DUNCAN: Please do! Here's an, here's... [indistinct voices off microphone] Dr. von Foerster has some comments.

VON FOERSTER: [off microphone] I would like to try to clarify the [...]

VOICE: [overlapping with VON FOERSTER] Yes, I don't want to hear you do that. [louder] No, no, go to the microphone.

VOICE 2: Yes, I would like to hear what he has...

VOICE 3: Use a mic!

VON FOERSTER: [on microphone] Pause. Entropy, like velocity, weight, and so forth I express in numbers. You see, these are ten to the sixth, x per degree. And then you have. Or, you see, 500 minus your second, something like that. These are numbers, and therefore, quantities. However, if you interpret them, and this is what the physicist does when he writes a book, when he invites you to interpret these numbers. And the moment when they are interpreted, they are qualities, and that means it is now the quality of a velocity, of a speed, of a weight, of a mass, of an entropy, of a temperature, of an energy. Which is now giving away, of course, what is meant by that number. So, when he said entropy is, in his way of looking at the whole thing, a quality...

VOICE 4: It was not a quality!

VON FOERSTER: Well, he said he had two rubrics. The left rubric on the positive axis of that slide was quantities, on the right he had qualities. Yeah? Of course we all know that if you plug a number into the whole thing, it will be a quantity. However, he wanted to stress, I think if I understand it correctly, and I'm here in order to understand what he wants to say to me, and then I say "Aha, my friend Duncan wants to draw my attention to the *qualitative* properties of that number, which is called entropy." And, in that sense, I think he wanted to point out that if you wish, entropy as interpreted by physicists is a measure of order seen out there, and therefore, if you wish, high order, low order, mabe good, maybe bad, may become qualitative. Did I try to comprehend you, Mr. Duncan, in the way in which you want to tell me your story?

DUNCAN: Much better than I could do.

VON FOERSTER: I'm surely not, because otherwise I could not have told you what you said.

[laughter, applause, cheers]

DUNCAN: With due respect to the other opinions, I... well, I thank you for your eloquence.

HOST: Okay, we have time only for one more question, because we don't want to run late. I don't know who was first. You were first? Okay. You can...

QUESTION 6: Go ahead, I'll [...]

SPEAKER: Okay, you can always talk to Dr. Duncan afterward.

QUESTION 7: Ultimately, isn't it a question of whether or not we want to recycle our materials, which industry feels are not worth, or actually it's cheaper for them to go ahead and gather more resources from the Earth, from the lithosphere...

DUNCAN: Because they externalize the social costs which we absorb. It's a tragedy of the commons phenomenon.

QUESTION 7: Right. Industry will, at some times when there is a shortage, go back to landfills and spot recycle; they'll dig up and try to get the tin out a, you know, out of a landfill, and it seems to me that that's kind of a backwards way to go about it. Entropy to me just means, you

know, I can look at a landfill and I can see entropy, it's that simple. And, ultimately, I think we have to put pressure on industry. As consumers, it's totally a consumer thing. We have to tell the consumer, we have to communicate to the consumer that, you know, it's... nobody is going to lose out, just the consumer. Industry will keep going, and, you know, they can even recycle out of a landfill, but we have to put pressure on industry to make markets for things that we recycle.

DUNCAN: The markets are developing simultaneously, and industry is coming around. In the final analysis, we're all in it together, and industry has got to do what is best for its own survival, just like all of the rest of us.

QUESTION 7: But, industry and government are really slow, are very slow to respond to what responsible people see as the solution, as the only...

DUNCAN: Okay, let's put legislative pressure, political, economic pressure, boycotts, a lot of other things, sure, let's speed them along the way to better ways of doing things.

QUESTION 7: Yes, I also have this paper that I'd like...

SPEAKER: Thank you very much, Rich, and for the lively discussion. We will now adjourn, meet in the other room, 338, at 1:30 to hear Professor von Foerster, and you've already got a fore-taste of him.

[program ends]