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Donatella: Can you tell us something about the change in the idea of nature?
00: 08: 07: 01 The main change that came about in the idea of nature was somewhat of an organism to a machine, and in the 16th century nature was still considered as it had been in ancient times to be a living organism. And the body, soul and spirit of the human being was the same as nature's body, soul and spirit. So the cosmos waves are made up of matter, of earth, fire and water. And ether in the heavens above, and there was a soul of the world that was represented as female. That really came from Plato in his (? ?). The soul was female and she turned the earth within herself, so this was the motion that was given to the cosmos. Doing the daily revolutions and the annual revolutions.

00: 09: 18: 14 And then there was a spirit, the spirtus mundi, that came down from the heavens and transmitted motions from the celestial sphere of sound, mixing it with the air and down to the earth. So the body, soul and spirit made the whole cosmos of living organsim and the earth itself was alive. It had physiological systems, just as the human being did, respiration and circulation and reproduction, and even elimination. When there was an earthquake it was as if the earth was breaking wind. Well during the 17th century, gradually this idea of the cosmos and the earth as a living organism was replaced by the idea of the machine. So between about 1500 and 1700 we have this immense change in metaphor. By the end of the 17th century, nature is dead, it is made up of inert particles, they are set in motion by God at the beginning of time. And the motion is passed from part to part. It operates as if it was structured like a machine, and God is an engineer and a mathematician. And the whole idea of life now has gone from the cosmos. With the death of nature, the implication for human progress change.

Donatella: How do the implications for human progress change?
00: 11: 28: 15 Well if nature was alive, then one must make a (? ?) to it. There are certain things you can't do, you do not dig into the earth to take metals and rocks, because those are alive.
So mining the earth is a problem, there is an ethic associated with mining the earth, there's an ethic associated with cutting down trees. There's an ethic with damning up brooks, all of this have to..there's an accountability between the human being and nature. It's an I THOU relationship, so the ethic is one of a human being relating to another living being. With the machine nature is dead, and so the control and domination of nature is sanctioned thereby. It's legitimated, you don't have to worry about the consequences of cutting down whole forest, or building large damns.Or mining the earth as deeply as you wish to extract gold and silver and copper in order that human beings can use natural resources in order to upgrade their own quality of life.

Donatella: What was the connection between the consequences of the death of nature and the social divisions within the society?
00: 13: 21: 13 Well the social implications are that since the scientific revolution, we have a philosophy of science, a mechanistic philosophy of nature. Which looks at nature as something that human beings can engineer and manipulate. We have had this philosophy only for the past

three hundred years. For all of humankind, for at least 10, 000 years and in all, other cultures but Western Europe, there's been some form of an organic or animistic relationship between people and nature. Some form of accountability.
00: 14: 13: 13 Human beings now can do whatever they want to, because as capitalism begins to be the dominant mode of production, and of extracting natural resources. We look at the consequences as externality, if we pollute the water, or we pollute the air, or we cut down the forest in one place there is always some place else that we can go to and take more of natural resources. Now however, we're reaching the depletion of resources and pollution of the atmosphere and the water and the soils, on a scale that is global in scope. And we can no longer consider one country or one community isolated from the rest, we can no longer consider nature as an externality. We have to take the consequences of our actions into consideration.

Donatella: Do you think this situation had specific consequences for gender?
00: 15: 40: 19 Well, when nature was an organism and it had a female soul, and the earth was a mother, there at least was philosophy that supported the idea of womens' importance. And in fact, I think during the renaiscance, women had a greater role in the family unit and in some of the trades, and certainly as midwives women played an important part. Under the rise of capitalism women lost ground. They became not as central to firm production, for example, many of the roles were taken over by industry. Their roles in terms of helping to raise food, and in dairying and poultry raising, were taken over by large scale farming enterprises. So women, womens' role in economic production in the family unit declined. Women did other things. Their roles in the home and the life in the home, their socialization of children, their roles in creating a moral model for the men in opposition to the amorality of the marketplace changed. Their role in increasing domesticity, in making the home a place of refuge for the male in the capitalist workplace changed.

00: 17: 34: 00 So womens' role did not decline in terms of the amount of work she was doing, in fact her work actually increased. Because the standards of what made a good home actually rose. But her place as part of the productive unit declined, also in medicine women had had the main role as the bringers of children into the world. And in England with the 17th century invention of the foreceps, the control over reproduction actually began to pass into male hands, as liscensing laws precluded women from obtaining the skills.
And obtaining the education that was necessary to be liscensed as a midwife. Now in the rural areas much of this continued as before, but the status of women with regard to their own reproductive capabilities, and their own control over it declined.

Donatella: How does all of this relate to women, science and technology?
00: 19: 10: 06 Well certainly women were excluded from science in the early periods, in the 17th century women were excluded from England's first scientific society, the royal society, and the Dutchess of Newcastle who considered herself a scientist and a woman who wrote about science, tried to visit the royal society. And she finally was givin permission and some experiments were set out for her. But women did not play roles in science, as scientists, in the 17th and 18th century, except as they were associated with the father and or their husbands as assistants to them. And they may have done much of the work in science,

and actually made contributions, but they did not recieve the credit for this.

Donatella: Do you think the absence of women from science and technology gave these fields certain characteristics?
00: 20: 44: 12 I think that's a very hard question to answer. There's a great concern about what would a feminist science look like.
Would it look different from the science that we have today.
I'm not sure that the structure of mechanistic science would look different, but I think the kinds of problems that would be researched both in the areas of technology, and in the pure sciences. As science is used to better human life and also nature's life would possibly be different. If women were part of the funding agencies and help make the decisions, if more grants were given to women, the kinds of problems that women might choose to work on might be different.

Donatella: What is the ecological point of view?
00: 22: 31: 24 Well the ecological model sets process as primary, rather than parts with force coming from the outside. So if one looks at his process as the source of energy, and looks at energy exchanges, not just within the factory but what happens with the factory and the surrounding environment.
It's pollution of the water and the effluents that are released into the air are all part of a single process. And that air and water is just as much, just as central, then you will have to take that into consideration, and ecological thinking is based on that idea.

Donatella: ..the ecological approach...
00: 24: 02: 01 Well one idea that's been revised, is the idea the earth as an organism where the respiration of the earth and the circulation of the waters, and the soil as being the earth's skin are all interconnected. And if you do something to one, there are going to be implications for another part of that process. And I think this is the kind of thing that women are particularly concerned about, women are living, spending much of their time in today's society in the household, in the home where these kinds of processes, they are concerned with processes in much the same way that the earth itself is a much larger home.

Donatella: What happened with the development of the mechanical approach to nature?
00: 26: 19: 07 Well I think we need to develop a science that is non-mechanistic. The mechanistic science worked very well for the period of the industrial revolutions, for the last three hundred years. It helped to develop and raise the standard of the quality of living for human beings. And yet it had these social costs for the lower classes for the poor for the third world, the so-called under-developed world. They were not part of the same kind of progress and the rising quality of life that Well the industrial revolution, of course, started first in much of western europe and america experienced. So I think now we're on the verge of a new revolution, an ecologoical revolution for the 21st century. And that will entail changes in production, changes in reproduction and changes in consciousness. We need some new kind of economic form not just a green capitalism that takes externalities into account. But some kind of a steady state economic situation which will not put extra stress on the whole living resource base of our existence and the rest of the biola of the planet.

00: 28: 04: 07 We need a change in reproduction also which will be part ofsustainable development. Where as peoples quality of life is improved

by developing along the lines of ecologocal reciprocity, ecological sustainablity the population will come into balance not through methods of birth control which use methods of harsh kinds of reprodouctive methods or rules or anything like that. But will develop as a natural part of the transition. And we need a new kind of consciousness. A consciousness that is ecological, that is ecologicaly based. That is not mechanistic. And we need a new science that has different assumptions than the mechanistic assumptions. Which takes context into consideration. The whole context of the air and water and the enviroment around the factory. That makes processes central to thinking. That treats people not as a duality. People or culture as opposed to nature but as part of a single unity. And a culture that does not see the animistic model as a basic model but as a process oriented model.

94A
Donatella: ..social implications of these changes...?
00: 01: 13: 20 Well the industrial revolution, of course, started first in England and in Europe. But then it moved to New England in the 19th century. And in New England it really begins with the clothing industry, here young women are employed from the farm families to come and live at the textile mills.
Also whole families are employed in the textile mills, and they have different jobs according to gender, and so women do many of the intricate operations in the textile mills.
Where they do the drawing in and some of the spinning operation.

Donatella: Can you talk a little about industrialization?
00: 02: 55: 03 In New England the industrial revolution took place mainly in the 19th century, with the growth of the textile mills.
But it was part in parcel of the mechanization of nature in New England. America lagged behind Europe, and so it experienced these great changes in the early part of the 19th century until about 1860. With the growth of the textile mills, many of the New England farm girls came to the early mills and worked. They lived in boarding houses there, and they carried out a lot of the intricate operations within the mills. And they earned quite a bit of money, and they were able then to send some of that money home to their families on the farms, and they also received a certain amount of independence and education. They had to attend church but they also had access to libraries, and many of them wrote articles for journals. And so the New England girls were considered to be very well educated, and their role in textile production seemed very positive.

00: 04: 36: 12 However, as immigration continued from Europe in the middle of the 19th century, many of the new immigrants were willing to work for lower wages. And so they replaced the girls, the farm girls, who had worked during the early stages of the industrial revolution. An important change took place on the farms also because New England were not only industrialized but the farms became very specialized. New England became a dairying area, and a lot of the farms specialized in dairying, and men began to take over much of the dairying operations that women had performed. Women had milked the cows and made butter and cheese, and now they transferred their imperical knowledge, which had been passed down through the generations to men, then articles were published in the New England farm magazines about how to make pure butter and fresh milk, and how the pastures should be green and with....sunny, so that the milk would be of the highest quality. And a lot of the knowledge that women had passed down from mother to daughter, now was given over to men and became part of the industrialization of farming, and the mechanization of farming.

00: 06: 29: 18 Another place that womens' roles changed was in poultry, they had been the caretakers of the chickens, and geese, and ducks. And they had gathered the eggs and fed the poultry, and also slauthered the chickens and prepared them for the table. Now men began to take over the poultry business also, and womens' role as poultry tenders declined. Now this did not happen universally, of course, many women still continued to raise chickens and sell the egss, and therefore have their own so called egg money. But the need to produce foods for the growing cities meant that the poultry industry also became specialized, Similar process in the vegetable, in vegetable production.
Women had had their vegetable gardens outside the farmhouse door, and now truck gardening became a specialization.

00: 07: 51: 16 So womens' role changed, their roles inside the home were elevated, where they could get white flour, for example, from the wheat farms of New York state, they now were expected to make better kinds of breads and pastries. And where they didn't have to make their clothing anymore, because they could buy the textiles from the mills. Now they were expected to make the clothing from the prepared textiles, and they had to make more clothing, and they had to keep them cleaner and neater. So the standards of domesticity were elevated, women had more work within the home itself. They also, however, did many of the women, did have more time to learn ond to study nature. They collected flowers, many of the foremost botanists in New England, were considered to be women. They wrote science textbooks for children, they taught in the grammar schools. And in this way they began to enter the field of science, especially as it reflected on the education of children. So I look at reproduction as having four aspects, reproduction of life, of children; reproduction of daily life within the home, the socialization of children, and then the reproduction of the political order. Womens' role as bringers forth of children began to go down as family sizes went down. The labor that was necessary when the family was its own productive unit, was not as essential as the farms became smaller and more waged labor was produced and available for the farms themselves. So the need for large numbers of children declined, and women typically might of maybe had five to seven or eight children in the 18th century, in the small rural community, now they might of had two or three or possibly four. So their roles in biological reproduction also changed.

Donatella: With the introduction of the machine...what happened with the natural resources...?
00: 12: 11: 12 One thing we see as increasing split between nature and culture, it becomes a duality, and nature is on a lower level. And women also are on a lower level, and men are identified with culture. This kind of split between nature and culture seems to be a phenomenon of the 19th century in America, although, it begins I think with the scientific and industrial revolutions, earlier in Europe. And...there's the consequence then that nature, being on a lower level, can be manipulated and controlled by men and by science, and by technlogy.

Donatella:
00: 13: 50: 16 Well the clock is the example, par excellence, of the machine. The clock is made of parts that work in a strict mechanical order, in linear causality., and the clock represents the cyclical motion of time. But it is represented by the pendulum clock, where there is a balance, as the pendulum moves back and forth. And so this idea of the pendulum clock becomes a kind of metaphor and model for the smooth functioning of governments. There's a balance of powers in government, and it also becomes the model for industrialization, because the clock rings to awaken the workers at five o'clock in the

morning. And then they go to work at six o'clock, and it rings at noon for them to have a break for lunch. And then in the evening at eight o'clock, it ..the bell tolls again for the workers to go home. So lives are regimented according to the sound of the clock. The clock itself is very much like the universe, it's a model of reality. Reality is a machine and it is made up of these parts, and the parts can be repaired from outside as the clockmaker repairs the clock. So human beings can repair nature if something goes wrong with nature.

Donatella: How did people's lives change with the clock?
00: 16: 22: 16 Well peoples' lives before the advent of the time clock, and before the advent of the pocket watch, were very much regulated by the rising and setting of the sun, and by the phases of the moon. And by the agricultural festivals that were oriented around the solstices and the equinoxes. So peoples' lives were very much organized by the agricultural needs for planting, and harvesting, by the length of daylight, the amount of time that they could work outdoors versus the amount of time that they spent inside during the winter, and in the shorter days. After you get electrification along with industrialization then you can have an even and uniform workday.

Donatella:
00: 18: 42: 03 Well with the advent of genetic engineering, I think the mechanistic model is pushed another step farther. n a sense toward its ultimate conclusion. Because people can now manipulat life itself, and what .. in a sense what we've done, is to totally change the face of the earth by cutting the forest and polluting the brooks, and building damns and large scale irrigation systems. So that we are managing nature itself, and changing it for human needs, now what we're going to do is engineer life to fit that changed artificial environment, so that we can make crops that have greater tolerance for salts that have accumulated in the soil. And we can make cows that produce milk faster and in greater quanitities. And we can engineer our crops to bear greater fruits. This is exactly what Francis Bacon predicted and advocated in the 17th century, that we should artificially propagate our fruits and vegetables and animals, in order to increase productivity for the benefit of humankind. And I think the bio-technology model which is based on mechanization is very much antithetical to the ecological process oriented model, where nature is a kind of teacher and we must follow the laws of nature. And stay within the kinds of limits that nature as actor sets and creates for us in a partnership relation. Bio-technology moves a step further away, again, of trying to establish or reestablish a partnership with nature as actor, as mother, as goddess, as it was in the ancient world views.

Donatella:
00: 21: 49: 12 Well I think we can go in two different directions, one is an idea of growth and continual manipulation and control and domination of nature. In which case, some of the scenarios of the limits to growth model, of where there's growth and collapse that were popular in the 1970's, might be the outcome. Or we can go in the direction of sustainability, of seeing a revolution now that is needed at all levels of production, reproduction and consciousness, a new global ecological revolution. Along the lines of Ilia Pricogenes(?) idea of order out of chaos, we could consider the globe in a state of chaos right now, that will reorganize itself into a sustainable way of life. In which human and their needs for resources will be brought into balance with nature, and nature's ecological processes, and nature's production and reproduction.
Donatella & Antonello: the relationship of science & technology..?

00: 24: 26: 20 Well I think the rise of nuclear technology not only in creating the capability for the world to destroy itself through nuclear weapons, but also through the growth of and use of nuclear power in, for enegy production both have negative consequences for the future. And I think especially women who have spoken out against both of these. Women are very active in peace organizations, they've been very vocal and active against nuclear weapons, and held demonstrations such as those at Greenham Common. And they've also been leaders in protesting nuclear power plant as you saw at Three Mile Island, for example in Pennsylvania. I think a lot of this comes because of womens' recognition of themselves as bearers and bringers forth of life, and of children. And children..both womens' reproductive capacities are threatened by radiation, and their children suffer from deseases, from increased numbers of cancer and leukemias, that are part in parcel of the whole nuclear age. So women have been the leaders for life on earth and a peace movement that I think are compatible with the ecology movement, that we need to restore the respect for life and the living processes, both of nature and of women as bringers forth of children into the world.

Doanatella & Antonello:
00: 27: 54: 03 Well in some sense the computer is the essence of the mechanization of nature. Because the computer sets up the mind as machine, and the mind has the characteristics in a computer model of linear causal thinking. So the computer in the sense operates on the idea of taking bits of imformation from the environmental context, and manipulating it according to a set of equations and relationships. And then you can take that output and use it to make decisions about nature. So mechanistic systems thinking is enhanced by the kind of computers that we have now, it gives us greater power to make decisions about how to use the land. And we can track animals and their habits by connecting them up with electrodes, and mapping the land according to the movements of wildlife. So that gives us the power to control it even more.

00: 29: 22: 03 So the computer on the one hand has become the essence of mechanization. But on the other hand it does allow us the systematized knowledge. I mean we have it, we're her, we can't go back, so it does allow us to at least try to use our knowledge in a different way, to bring ourselves into a better, more sustainable relationship with nature. I think also there are implications for men and women, and the kind of metaphors for their use in computer modelling. And in computer games, where we have games like Ms. Pacman, and you have the games where you're trying to attack the mother brain, and so on. I think one needs to be very careful about genderization in computers as they're used in education and as they're used to bring differentially bring boys and girls into computer literacy.
Much of the early work that was done in education really focused on boys and boys needs, to the exclusion of girls.
And the way that girls were socialized to kind of stand back and watch while the boys actually manipulated the keyboard and the screen.

95A
Antonello:
00: 00: 36: 18 Well my idea is of ecological revolution, is that there are changes at all levels of human relationships with nonhuman nature. Changes in ecology, so in the global revolution we would go toward a sustainable ecology. Changes in production so that in the global revolution we would go toward a steady state kind of form of production. Not one that is necessarily growth oriented, and growth dependent. We would go toward forms of reproduction which allow people to have reproductive freedom to make their own choices, and to have the numbers

of children that can be sustained in relationship to the needs of ecology. And the numbers of children that there is going to be a good life for it, high quality of life. And it's a level of consciousness where we will have a new science that will legitimate a different type of world. Not a world that is based on the idea of progress, necessarily, but an idea of sustainability.

00: 02: 06: 12 So I think now the word sustainabilty has gained a lot of interest, in some senses becomes the new word for the 21st century, and perhaps will replace the idea of progress. It's a concept that can be developed in many different ways, but my thought is that, the global ecological revolution will take place over the next 50-75 years. In which we will gradually see our production brought into a better relationship with the land and its resources. And we will see population changes beginning to go down, so that the tremendous growth rates that we have seen over the past two or three centuries, where the rate of growth has been increasing, we will see that begin to turn, also. These ecological revolutions that I've been talking about, I think take place over a period of fifty to seventy-five years. In America for example, in New England , we see a change from around 1600 to 1675, between Indian ecology and Indian attitudes in relationship towards the land, to colonial relationships. Where Europeans come over with their animals, plants and (? ?), and have an ecological and economic impact on nature. And by the end of that 75 year period, you have a new way of life, you have new attitudes in the new world towards resources. And you have new patterns of production, and you have a need for more children, and therefore a need for growth in reproduction. So that's one ecological revolution that I would call the colonial ecological revolution.

00: 04: 27: 13 And then in the late 18th and 19th century, we have a change of similar magnitude that I call the capitalist ecological revolution, that is, occurring at the same time as we have industrialization. But in that case we're seeing again shifts in the way ecology is used in production and reproduction. And a mechanistic world view that legitimacy changes at the level of consequence. And that again takes place in a period in the US of about 75 years, between the American Revolution and about 1860, and then the patterns of the capitalist ecological revolution remain in place until the late 20th century. And I think now as we're looking forward into the 21st century, we are in a similar period of transformation, where we realize that we can not continue in the same way, in terms of growth, the megamachine, and the idea of progress. That we need new ideas and new forms of production and reproduction.

Antonello: Today the problem of scarce, finite resources is a global one. What can we do ...?
00: 08: 28: 03 Well obviously I don't think we can tell other countries what to do, I think they have to decide for themselves. I think we can move in terms of energy toward a solar age. In which people themselves have their own control over their own energy, and they are not dependent on capitalist production of energy. I think we can move towards a bioregional approach, where we're using the resources within our own communities and in our own bioregions, in trying to work towards sustaining them. The rain forest, perhaps, can be used in more of an extractive way, where the products of the rain forest can be used and developed without cutting down the forest itself. And without building huge damns in the rivers that run through it. And we can spend a lot more of our effort on conservation and recycling and on replanting our own trees. In planting trees in the northern hemisphere to help

counteract some of these effects. I don't think the north, the northern hemisphere can any longer dictate to the southern hemisphere what they should do. I think we need to cooperate, but we can't be the ones that say, okay we now have achieved a standard of living that we want, and we will supply the resources for that. And you can't develop toward what we have achieved. There is obviously going to be some kind of ecological rebase development, but that has to be worked out in terms of a self respect and the self determination of the countries themselves, without following in the northern capitalistic, imperialistic kinds of models that we've seen in the past.