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Antonello: Shall we begin by discussing the relationship between war and technology?

00: 01: 01: 04 Sure....until the second world war, research in this country was funded pretty much by industry or by private nonprofit institutions, particularly at the university. The Rockefeller Institution was one that funded a lot of chemical research and physics got funding from small entities, by and large. With WW2 and the great success of, particularly of the physicists in the case of developing the northern bomb site, working on radar, and of course the atom bomb. The military became very well aware of the fact that from basic research could spring things that would be useful to them in the future. Therefore, at the end of the war there was a real urgency on the part of the military.

Particularly the Navy recognized that something should be done to maintain the length that had been set up during the war to maintain the pool of scientist who were involved in the research that might be of benefit to the military in the future. And the office of naval research was set up in the late 40's.

00: 02: 21: 13 There was also a lot of discussion about how basic research should be funded in this country. And there was strong pressure for the establishment of a civilian agency that would be in charge of all research, and this however took a lot of time, there was a lot of politics involved. It was about seven years before the national science foundation was started, and it was a much smaller thing than was originally envisaged. Originally the thought had been that this agency would cover all research, both civilian and military. But the national science foundation just took a piece of the civilian research funding. Some civilian research was funded by the department of energy, and the..a lot of the research was funded through both the office of naval research and the air force and army offices that had

been set up in the interim when the Korean War started.

00: 03: 20: 21 The other thing that also happened was that after a real time of thinking that peace had come, the Cold War started and then the Korean War started. And again there was much more money put into military research at government laboratories, and this tends to be either applied research and development, whereas, what happens at the universities tends to be either basic research or applied research. But still the funding for research switched very dramatically towards the weapon side of things during the Korean War period. And lead to the establishment of what President Eisenhower called the military industrial complex. And to a pattern of funding research in this country that depended very heavily on military contributions up to the present.

00: 04: 15: 00 After the Viet Nam War, there were decreases in the percentages that were funded through DOD, partly because DOD had become disenchanted with the scientist during the Viet Nam War, because of the opposition to the war, and partly because there were cutbacks on the budget in President Nixon's time. Because he needed the money for the active carrying out of the war, and so he had to take it where he could get it. And it wasn't until the end of the seventies that again there started to be an increase in DOD funding of R and D, and it went from 40% in 1979, up to about 67-66% for the last few years. I think it's dropped a little bit in the last year or so, its height was at 67%, two thirds of all federal funding of r and d in this country came from the dept of defense. And people feel that at the universities this has not been very detrimental, they say this is just research funding like any other research funding. What difference does it make where you get your money, I do thisa faculty member will typically say, what difference does it make who funds me, I do the same research, it's good research, it's well spent money, and it just doesn't matter whether it comes from DOD or from any other agency. 00: 05: 48: 08 But in fact if you actually look at the picture from outside, and there have been a number of studies of this nature where historians of science have looked at what actually has happened, it turns out that the funding has had its impact at the universities as well, as it has in the general national r and d picture. And the general r and d picture it has been much more hurtful to the country because what it

has done is to deflect the r and d interests from the real problems that face the US economy. And has contributed to the fact that we have an increasing deficit, and to the fact that we are now a debtor nation, rather than primarily an exporter nation. We just are not competitive in the civilian market. And if you have this drain not only on the funding but also on the personnel that carry out r and d, towards the military, and I mean it just is obvious that this drains going take them away from the civilian problem and one can argue that the current situation is not very much due to this, or that it is very much due to this, I think that is a legitimate area of argument. But it certainly has contributed.

00: 07: 24: 13 At the universities it's also true that the focussing on problems of interest to the military has shaped the research that the country does. It does it in a couple of ways. First of all, the military do not fund all fields equally, they do select fields where the research might be of future interests to their program. And therefore the money goes into very specific areas which therefore in the last ten years has enjoyed a much greater increase in their funding than the other areas have, because funding increases have been slower in the things that NSF supports. The second thing that happens is, that within those areas there is also a distortion, or maybe that's a perjorative word, there is certainly a change in how the research is done and what it is directed toward. And if you look at the booklets that DOD puts out, both for the purpose of congress and for the purpose of telling somebody who's applying for a research grant how to go about it. They say that well, go and talk to a grant administrator, see how you might tailor your contract to fit the military needs. If your proposal doesn't get accepted first time around go and discuss it with him, and see how you can change the proposal so it will in fact fit into the pattern of what that particular branch of the military agency wants.

00: 09: 08: 11 And the work is directed by in large of proving something, it is not trying to investigate the physical world, the way it is, which is what one usually idealistically thinks that basic science is all about. It is to try and develop a knowledge about specific products of materials to take an example that will be useful to some part of the military program rather than studying the underlying physics of materials, for the sake of further knowledge of what those properties are.

00: 09: 46: 20 And in terms of technology, which was really your original question, it has ended up...the US with a plethora of high technology weapons programs that are firmly ensconced in the budget, and that I think we will be burdened with a good deal into the future. And despite rhetoric to the contrary these programs do not have any benefit for the civilian economy. A number of people who are part of the military establishment, have been quite open about this, rather than the former days when there were spinoffs from military programs into civilian areas. I mean the one that's usually quoted is computers and teflon.

00: 10: 38: 15 These days there are, what they call SPINONS, things that are taken from civilian economy and used in the military. And this concentration has been the thing that has worried my engineering and colleagues at MIT the most, because they cannot get funding to do things that they feel are really necessary for the civilian economy. And this is really what they are working to change, they see the writing on the wall, that there are going to be decreases in the DOD budget. And this is a good time to try and get the philosophy of how r and d is funded is funded in the country shifted around. So maybe we can get some of the federal funding directed at these very pressing national problems. ---

KISTIAKOSKY 46A Antonello: What is the position at MIT on this military money?

00: 12: 04: 16 At MIT most of the people are neutral. They take the point of view, as I say, that it's money that has no particular color or odor and if their colleagues want to get it and use it for their research, that's the colleagues right. And they do not take a position one way or another on it. When it looks as though DOD was the principal source of funding in the last ten years, then people thought that this was a good place to go for funds. The thing that has changed, as I say, is the perception on the part of a lot of the MIT engineering faculty, that they have to go and develop a new way of getting their research funded, focussed on different kinds of problems.

00: 12: 59: 15 There's a real difference between research and engineering departments which tends to be applied, and therefore it's more directly aligned with the next stage which is

development. And science departments such as the physics department to which I belong, where it really tends to be much more basic research and is sort of two steps away from any kind of a real development application. And the engineers therefore are the ones who are viewing these changes most actively, they have form committees to study what they can do, to insure them support when the DOD support decreases, and support for problems that really are of interest to them and of interest to the US.

00: 13: 51: 12 In the science department, mathematics and science department, there is a view by a majority of the faculty, which is the one I've already expressed, that it really doesn't matter where the funding comes from. There are a substantial number of people like myself who feel that there is a real hurt to fundamental research when it is always funded by DOD, I mean it is slanted it is colored by the fact that DOD selects fields of interest to it. And then there are some people who just genuinely feel that there is a very hostile world outside of the US, and we should be strong militarily. The concomittant thing is to have a strong research program for the military. That tends to be a very small group. There's one example that happened in the recent years, but this really became very public when president Reagan announced his idea of star wars, or what is called star wars subsequently, it was immediately criticized by large segments of the top scientific brass as being ridiculous in its concept that you could provide a perfect shield to the nation and even ridiculous at a somewhat lower level. And it meant with just an opposition that must have amazed the administration, and one of the things that they did to try and counteract this was to start a program called the office of innovative science and technology, then headed by a Dr. James Ironson. That was going to give money to the universities to do research on star wars or strategic defense initiative problem, and they were quite open about, Ironson was quite open about why they started this program.

And it was in fact to enlist the university researchers into the army of supporters of SDI. And this backfired very badly on him, instead it got the university scientist very much opposed to the program, not all of them again, but a significantly large group to really matter, and there was a pledge effort started in this country. The first two universities to start it were Cornell and Illinois, and they did it independently, and it was a pledge of university scientists not to

solicit or accept funds from the strategic defense initiative. Because of the very bad consequences to the technology base in the country and also because of the fact that it was a political maneuver that was being pulled on them. And this translated itself into a nationwide pledge effort. And I was one of the people who talked about the pledge here at MIT, and got signatures on the pledge here at MIT.

00: 17: 12: 18 And it was very interesting, I don't think we had one professor who said I will not sign the pledge because I think the strategic defense initiative is a wonderful idea, and I support it fully. But we had quite a number who said things like well, SDI will never work, so why shouldn't I take the money. Or I can't sign the pledge because I think that in the next few years SDI will be a very strong source of funding, and I don't want to cut myself out of this source of funding. And I don't think SDI is a particularly good thing, it certainly is never going to work, but I don't want to cut off my money. And there was one person in particular who when I phoned him said; I am very much opposed to SDI, I would really like to sign the pledge however all of my contracts have been transferred to SDI. It wasn't that he had applied for funding there, but that his contracts in other branches of the military had been transferred to SDI. If I refuse this money, I have to let all of my graduate students go, my post docs go, fire all of my technical staff, If I can't find a way to get funding from some other source, I can't sign the pledge.

00: 18: 43: 06 And that was one of the ways that SDI was able to spend its money in the first years, they just took over contracts that had been elsewhere in the military, because they got so much money, they had no way to really start a program from scratch, they took over things. And it did involve people like this person. But we got, I think it was 53% of the faculty at the top ten or twenty research universities signed the pledge.

And nationwide there were some, there was nearly 3000, yeah I think it was 3 or 4000 something like that. Senior faculty in institutions that sort of represents three quarters of all of the federal r and d funding, in the country, signed a pledge not to take SDI money. Now practically speaking; I don't know how much that damaged SDI, I mean Ironson went public with the statement well it doesn't matter if these people won't take SDI money, we can

always get two second rate scientist to replace one first rate scientist, and therefore it really doesn't matter if all these people at these top universities sign the pledge.

Which must have endeared the man no end to all the people who were taking SDI money, to be called second rate scientist by implication.

00: 20: 21: 24 He had a gift for saying things that just delighted his opponents, that is sorely missed in the present administration, which is much more thoughtful and careful about what it says. And they were subsequently proved, the people who signed the pledge were essentially proved right. Maybe they contributed to the slow demise of SDI, I hope to think that we did, by going public on our opposition to the concept. But pragmatically it was us plus the poll of the national academy of sciences, plus the fact that people from government labs signed a petition to congress not to increase the funding because the money was being miss-spent. Plus the fact that expert after expert testified that not only was the idea not going to deliver anything useful in the near future, but that the money was being misspent, was being spent so fast and wastefully, that the only way they could essentially justify the money was to have what were essentially media hoaxes to say they were making progress when they weren't really. And it was tainted by outright falsification like the Livermore Labs misrepresentation of the x-ray laser. And SDI is not in high repute.

00: 21: 54: 02 The other sides of that coin is that once something like that gets started, it is very hard to kill, we have the legacy of SDI, it's still in the budget, it still gets a heck of a lot of money. Something like.....it was a lot of money, and it's going to just take time to decrease that money. You can't just turn it off over night, congress doesn't work that way, they make small changes. So we're spending a lot of money on something that's of no real use to the country. ---

KISTIAKOSKY 46A Antonello: what are the social and political implications for the students?

00: 22: 54: 00 It has had a very real effect on the students, this is one of the most worrisome things at the university. At the undergraduate level it has an effect on the students, mainly

in the choice of jobs that's open to them when they graduate. There just has been a very real shift in where students can get jobs from civilian directed jobs to jobs that are in companies that deal with sizeable amounts of military research, that's where the money has gone in the last few years. Towards the weapons programs, McDonald- Douglas and all of those places. And it is just true that a student who wants to get a job in a company that's not involved with military work, is going to have a very hard time to do that, unless they are resally willing to take a job that pays less or unless they're good enough so they can get a job at some very prestigious place that is engaged in really basic research. That's for the undergraduate..

00: 24: 11: 22 In addition to that since there has been so much acceptance at MIT at the idea of doing on military funding is perfectly okay, the students are much less likely to question whether it's such a bad thing that they get paid 40, 000 dollars a year by a company that does military research, rather than 30, 000 dollars a year by a company that doesn't. There have been students on campus who have worked very hard on this issue. A friend of mine who was a graduate student here, Robin Wagner, started up a chapter of student POGWASH, which ran an alternative jobs fair, still do run this alternative jobs fair. Where students can go and look at what is available in companies not related to DOD. But there has been a change in the student body, in the what you might call the mind set of the student body, and I'm sure it's not due to these attitudes at MIT, but certainly the attitudes of MIT have done nothing to change it.

00: 25: 25: 05 Namely that the important thing is the students own well being, financial well being, material well being and the thing to do is to go out and try to find a job for a lot of money and forget about social consequences. I would say that this is somewhat reversing itself in the last year or two, it's too early to really know whether I'm endoshing in wishful thinking or whether in fact there is a changing in the attitudes of the students as they are coming in. And I think as the cold war has decreased in its credibility, I think that some of the attitudes at MIT are also being much more accepting of the idea that one should examine the social consequences of what one does. But if it's a real effect it's in its very beginnings, I hope it will be something that continues.

00: 26: 32: 23 At the graduate student level the problem is much more serious because graduate students are supported by research funds, therefore if you have a lot of refunds in a particular area, those are the areas the graduate students go into in larger numbers. Because that's where they can get the support, and you might say well, they have the choice of paying their own way through graduate school and studying what they want to. That is unrealistic except for a very small fraction of the population, it was just an enormously expensive thing to get a Ph.D. in physics, if you want to be self supporting.

00: 27: 16: 20 And that is one aspect, in most cases it's just the pushing of students into specific areas, sometimes within the areas it does in fact run into problems like restrictions on publication of research. MIT does not allow classified graduate student research on campus, matter of fact, the policy is no classified research on campus, even though Lincoln Laboratory, which is part of MIT is very largely classified research I think 96% DOD funded and I don't know what fraction of that is classified. But there are students who do work that's related both with Lincoln, very few of those and a larger number that do work that is related with Draper Laboratory which used to be part of MIT but separated from MIT in the early '70's. However, there's still strong links between MIT faculty and Draper Lab personnel. So students do do work over there, and they also sometimes do work that is related to other programs and on occasion I am told that it has been necessary for them to take material out of their thesis that they worked on, because that material is classified and cannot be part of a thesis. But to my knowledge there has not been anybody who has not been able to write a thesis because of working on a classified research. But when they graduate, there again is the same problem that faces the undergraduates. If you get a lot of students doing particular kind of research and there's not much demand for them and academia, then the place they can easily get a job are in the military related laboratories like weapons programs outside of academia. ---

KISTIAKOSKY 47A

00: 00: 30: 00 early morning Boston. Railroad tracks. Cars on freeway, pan to railroad

tracks. CU of blue CONRAIL train engine. Skyline of Boston. Train drives through picture. Two firetrucks drive through scene, camera follows last truck. Traffic on highway.

00: 04: 16: 08 railroad yard.

Antonello: Does a scientist have a social responsibility?

00: 04: 30: 14 I think a scientist definitely has a social responsibility, but the level at which that is exercised is a difficult question. You mentioned earlier the story of Dr. Carlston, who was working on an agent for I think improving the pollination of certain plants.....

00: 05: 10: 18 .No I believe that the scientist have a responsibility for what they do, and it is one that they should consider very seriously. But it's not always easy to know what your responsibility is. The example that is sometimes drawn on is the experience of a biologist, Dr. Arthur Galston, who developed a chemical to aid in the making soybeans flower at the time of the Viet Nam War, and it was discovered that this was also very useful as a very powerful defoliant and was used during the war as a defoliant. And he was enormously distressed by this military use of what was intended as an agricultural product. The reason I bring this up, is one cannot always know what the outcome of scientific research will be.

00: 06: 09: 21 However, in many cases scientist know very well, that if they are working on a particular aspect of material science that the purpose of this is to build better re-entry nose cones for re-entry vehicles, or what have you. And then they should consider whether this is something that they want to commit their research to. And there's also the political aspect, it is in my opinion, a political act to work for the military, it is in essence saying that this is research that should be done. And if this is something that the individual believes that this is something good for the nation, it's something that the individual should do, than that is a judgement that I may not agree with but it is a judgement that that person is entitled to make. But that is not what people have been doing, they have been completely pushing the whole issue of responsibility to one side.

00: 07: 10: 18 At MIT, social responsibility has absolutely no value to a faculty member. The thing that one gets promoted for, the thing that one gets tenure for, the thing that one gets

increases in salary for is research. And bringing in funding to do that research. MIT faculty have one third of their academic year salaries paid from money that they raise themselves by and large. All of their summer salary.

Graduate students are supported by funds that are brought in. Obviously the post docs and the staff are supported by the funds that they bring in. There is just very strong pressure from the institute to get funding for research to do the really first rate research that will bring in more funding. And it is a trap if you like for the faculty member, because this is what you're here to do and that's what you're suppose to do. A secondary thing is education, it's very nice if a faculty member is an excellent teacher, but there have been a lot of excellent teachers who have not gotten tenure at MIT because it was felt that the quality of their research did not justify that tenure. It always comes back to the statement that it is the research that gets the tenure. And as I said, social responsibility doesn't fit into the picture at all. People might argue with me and say, well, service to the institute is a form of social responsibility and in fact in any tenure case there's always a list of the committee that the person has served on. But believe me somebody really done first rate research, brought in millions in research contracts and published a whole stream of things. It doesn't matter if they've never sat on a single committee. The only thing that might really hurt them badly was if they had never educated a single graduate student. That is the one thing that should go along with a very good research program is in fact that you do have graduate students in it.

00: 09: 37: 04 And what can one do to change this? Well, idealistically one can make the MIT administration, the next administration of MIT up from people who believe that social responsibility is something that should be exercised within the institute, not just taught in courses. We do have courses that deal with ethics and social responsibility but not in the context of the institute itself. If we had an administration that acted in a socially responsible way and asked its faculty to act in a socially responsible way, that could make a difference at the institute. And it would have a big impact on the students. Because what the students learn now from their professors is that social responsibility is irrelevant.

There are a lot of very good people on the faculty, there are a lot of very good people among

the students, so inevitably you get some socially responsible people in this mix. But it is in spite of the ethos here at MIT rather than because of it.

00: 10: 55: 09 Nationwide I would say MIT is probably not much different from most places in this respect. In a place like Harvard which is very different in its center of gravity. It has much more in humanities and social sciences and areas like that, than MIT does. We have much more in engineering than they do. And therefore it's a very different kind of environment, but they have also had their troubles. And the fact that they have faculty members who falsify data and tried too build an academic career on the base of misrepresented research data, leads me to believe that that is also a place where success is more important than social responsibility, pragmatically. And I'm not keyed into all the universities nationwide but it would surprise me if MIT were very different from the others. Except at MIT we have so much research that can be related to military things, it is something that is much more has become much more to my notice. ---

KISTIAKOSKY 47A Antonello: Where does the idea of NEUTRAL science come from?

00: 12: 34: 17 Well, it's coming from the good old days, you know I have colleagues who have now retired who were active in the 20's, in the days when quantum mechanics was being developed. You know the days of wonder when the new physics was growing and they were discovering the positrons, the neutrons and all of the things that underlie the really fantastic world of physics that we know today. Our understanding of the physical world has just completely changed in the last century. It's just amazing at how different at the way we think about things. And these colleagues have a picture of physics really as something that is very different from what it is now. Now it tends to be big teams and scientist with a lot of money. Even in the theoretical areas there's money involved because theorists nowadays by in large use computers, and so they want to have the funding for the computers and they have to support the graduate students, so they need the support for the graduate students.

00: 13: 46: 01 So physics has changed then, I mean it involves a lot more money, and its

gotten in most are involves large groups of people rather than the single investigator in his or her laboratory. And that's where the idea of neutral science comes from. Because if you truly are disconnected from the end use of what you are doing, just pursuing a knowledge of nature, then in fact you could think quite reasonably that what you are doing is value neutral. The field that I worked in for many years, elementary particle physics, was a field that I think by and large is value neutral and people disagree on this, but I really think that the major application of particle physics... particle physics deals with three of the four fundamental forces of nature, the strong force, the weak force and the electro magnetic force. Electro magnetic force has by and large been understood since Maxwells days, not completely, we've learned a lot from particle physics experiments about this. The strong force if you like was pragmatically understood by the people who developed the atom bomb, and that is the primary application of the strong force that we're going to see, both fission and fusion energy. The weak force is in fact so weak that it is not something that is likely to yield any practical application in the everyday world. And that's why I say, I think that research is in content, value neutral.

However, it involves these very large accelerators which cost a great deal of money, very large experiments which cost a great deal of money. It takes a large amount of talent, teams of three, four hundred physicists working on a single experiment. So it does in fact take up both scientific funding and scientific personnel that might better be spent on something else. I mean how many people are truly interested on whether their three generations of quark or four generations of quark, thanks to the experiments that were just taking place at Cern, now I guess Slack claims a share of the credit, we now know with a fair degree of certainty that there are only three generations of quark. I think that is a correct statement.. 00: 17: 01: 02 Thanks to the work that has recently been done at Cern and at Slack, we are closing in on the answer of how many generations of quark there are likely to be, eventhough this has great implications for our knowledge of cosmology, and how the universe was started, it is to the average layman, like counting how many angels can dance on the head of a pin. How many generations of quark there are is just something that has no real practical application. So, it's taking a lot of money, a lot of personnel on a problem that many people would argue is not a very interesting question, and there's also, there are other aspects like

it's unlikely one will learn anything terribly new in this field unless one builds very much higher accelerators. Which again is a debatable question.

00: 18: 24: 21 But it becomes important when you start talking in terms of something like the national science foundation budget, where the smaller science has been squeezed by taking the money for the bigger science. Under President Reagan high energy physics became a symbol of national pride and other sciences, scientific efforts were underfunded in order to make it possible to continue the funding for the high energy particle physics. So you know there are consequences of that kind towards pushing a program like that. What is the responsibility of the scientist for something like that? Well, when I was in the field and a student came to me and said, I'm thinking of doing graduate work in particle physics, can you tell me about it, I was very frank about the fact that although I thought it was an enormously interesting field, and I do to this day, the developments in particle physics, as I already have said, have changed our understanding of the physical world completely. I said the things I've just said here, which are that it does involve this big team effort. There is the problem that the funding won't be infinite, there may not be room for many scientist in it in the future. However, if the only things that really interests you is doing work in particle physics, then you should be one of the very few who try it if you just are looking for an area of physics to make a living in, then look somewhere else. ---

KISTIAKOSKY 47A Antonello: What is the relationship between science and women. Can you tell us something about your own experience?

00: 19: 59: 00 I was very unusual in my generation, I'm 61 years old, so I come from a generation where most women did not become professionals of any kind, they stayed home and had a family and took care of her husband and did nothing else. I think that one of the things that led me to this, and it's probably the dominant thing, was that when I was a girl my father was quite outspoken about the fact that i should look for some kind of employment to support me, I should not rely on a husband to support me. But that I should develop a profession or some form of employment that would support me in a comfortable style, and it would be very nice if it were something that I were very interested in, rather than just a job.

In the end of the thirties this was not something that middle class girls in the US were hearing from their parents. And I took it very seriously, and in fact I always thought of myself when I was in college as somebody who would go on and do something. Initially I thought I'd go to medical school, then I decided to go to graduate school. And taking myself seriously that way I think it saved me from a lot of adverse affects of the, sort of the society I was buried in, I was just different from other people. I was one of the people on the outside, I wasn't one of the girls. And when I went to graduate school, I was one of I think it was four women in my entering class, I was the only one who ended with a Ph D., and it wasn't because I was that much smarter than the others, they just could see that if they got a Ph D. they weren't going to get any jobs that would interest them and they decided it wasn't worth doing the graduate work. I just assumed it was some kind of hubris that if I wanted to do something I would end up doing it, so I got my PhD. and just sort of wandered my way up to where I am now. It was a random walk kind of path, because of the fact that I got married and had a couple of children along the way, and that did not lead me into the ordinary very straight path to academic tenure that was typical of my male counterparts, but I did eventually end up tenured at MIT. And I managed to do an awful lot of very interesting research along the way, and it by and large has been a very good experience.

00: 23: 13: 04 I have encountered very negative attitudes on occasion, perhaps they were most outspoken when my children got a little older and I started to work on women's issues. I got the American physical society to set up a committee on women in physics, then I had chaired it in its first year. I have a number of delightful quotes that physicists said to me at that time. The one that I like to repeat most is one that was said to me by our present science advisor, Dr. Farmlay, I met him at an American physical society event, and he said to me, I don't understand why you're setting up a committee on women and physics, there are only two women in physics, and I know them both, and they're both very happy. And I know who he meant, he meant Chen Chan Woo at Columbia and Getrude Scharf Goldhubber at Brookhaven. He didn't mean me and he didn't mean any of the other 700 odd Ph D women physicist that eventually responding to our committees questionnaire.

00: 24: 24: 06 But you know that's sort of what the attitude, women were irrelevant to physics, they didn't exist at any noticeable level. They were a very small percentage, 1.8 percent of all the Ph.D's in physics were given to women in 1958, that's an all time low, since the all time high in 1920, which was 19 percent. As a scientist I have to be honest, I can't just say 19 percent without telling you what the uncertainty on that is and the year that 19 percent of all the Ph.D's in physics went to women, it was 4 women in physics. Whereas, in the 50's the 1.8 percent was probably something like twenty women, that order of magnitude. So you know the numbers hadn't changed that much, but the percentages had slid dramatically over those years. It's not back up, I believe that now the percentage is the order of 10 percent, which is not great but it's the factor of five increase over the years.

00: 25: 54: 04 And you know, when we sent out those questionnaires to the women physicists we got back very few women who said that the field has really discriminated against me, but then they would go on to tell their experiences, and it really sounded as though there was something that was active in making it very difficult for them to function as professionals, even if they didn't recognize it as discrimination, they were encountering difficulties that were not typical of the average physicist.

And even more than that, those of my colleagues who are very open about what went on before 1970, say of course we discriminated against women, we never hired them, we never thought that these were people we would hire for the faculty.

00: 26: 46: 00 And Harvard is an example in question, I believe it was about 1970 that the dean of arts and sciences said, they'll never hire a woman professor at MIT.... sorry at Harvard, they'll never hire a woman professor at Harvard.

And then actually, it was about 70 I guess, then five years later, the statement was we would like to hire women professors at Harvard, looking very hard to find some who are qualified. And then another five years later, we are hiring women professors at Harvard, and we're looking even harder to find more at that time, they maybe had five or so at Harvard. It's just been very slow and the fact that MIT has a large faculty is due to a real push on the part of the administration during the presidency of Jerry Reasoner. Encouraging

all the departments to hire women faculty long before there was an affirmative action pressure to do this. And therefore well before other institutions in the country did ---

KISTIAKOSKY 48A Antonello: Is the discrimination against women in the field of science a social problem or is it a problem with the field itself?

00: 01: 12: 02 There are two aspects to this, and one answer to your question is yes, the nature of science is very masculine, it was cast in this mold by the fact that it was largely men who did it, up to the very recent present. And it developed very comradely masculine kind of flavor to it, and therefore if you had very few women they tend to be oddities in this society. That's again a social aspect, but a slightly different one than what we were touching on before. And some women deal with this very well, they are able to be one of the boys and deal with it very well. I understand that in France and Italy, the women scientist have the luxury of being totally feminine, and also being accepted completely as scientist. But in the US there is a certain dichotomy between very feminine behavior and being accepted. If you're very masculine then you get criticized for not being a pleasant person, if you are very feminine then you are viewed as not being cast in the mold of a real scientist.

00: 02: 48: 03 The other side to the coin is whether really is something about science that makes it easier for a man to do it, than for a woman to do it, or again on the other side of that coin whether science done by women would be different from science done by men. I have thought of myself as a feminist since the early seventies, but I have friends now who are feminist scholars, who use the term in quite a different sense than I use it. And they would say that science done by women would be different, that quantum mechanics would be done differently and I just do not follow those arguments, I do not understand it.

00: 03: 35: 20 There are fields where it would make a difference, it already has made a difference. The fact that you now have a lot of women in medicine has changed the problems that medical research does. There's now a lot more research on womens' medical problems than there used to be. I mean, medical research used to be weighted very heavily toward male problems, and now there's much more time spent on typical female medical research

problems. So you know in areas like that you can see a straight forward change. In intermediate areas like biological research, people have made a very good case in individual...in the case of individual research that it was colored by the fact that the researcher was a woman. Evelyn Fox Keller did a study on the woman who won the Nobel Prize for her studies on corn, and the names gone out of my head at the moment, it will come back, and you know, it was a fairly convincing study that the womans' intuitive approach to science was what lead her to do a kind of science, it was completely out of coordination with the dominant stream which was very quantitative microbiology. And because of the fact that she did a very different nature related kind of research, she came up with answers to a question that the more quantitative scientist weren't able to answer. Eventually they did, and it was recognized that what she had said was in fact correct, and she then got the nobel prize, but it wasn't until the quantitative microbiologists had essentially verified her results that this happened.

00: 05: 36: 18 But in the field of physics I really find it very hard to see that I would of done different research if there had been a lot more women in the field, different in terms of how I analyze the data, how I built the equipment, even how I choose the problems, but that may just be because I am a product of a particular history and it's very hard for me to see how an alternate path might of changed things. You know I can see how things might have changed if I hadn't gone into science, I don't know where I would have ended up. But to see how I would of done different science because I'm a woman, I can't really do it. ---

KISTIAKOSKY 48A Antonello: What do you think about the idea of progress?

00: 07: 14: 08 Well, you know in principle, it's true. But unfortunately principle doesn't seem to be very strongly active in the world today. The US just invaded Panama and killed some 500, 600 Panamanians to extricate one dictator, 220 of these people or more are civilians. You know, I don't view the society that develops to where it can justify this kind of action, and it does. Most of the American people are delighted that our president took a strong stance and got Noriega out. I do not see how this is possible. But you know there clearly are things operating that do not permit the world to run on principle, given that, technology is

not going to be used for the betterment of mankind automatically. It's going to be used for increasing the profits of corporations , for increasing the power of the nations that have power. For making it possible for small nations perhaps to be able to have a weapon that they can blackmail a big nation with.

00: 08: 37: 08 It isn't at all clear that technology will be used for the betterment of the world. But if you look at the alternatives, suppose there had been no progress in medical science, I probably wouldn't be sitting here today talking about all of this. I would have died in my first or my second childbirth. The first woman scientist in the US Jane Coldon was a botanist who got an international reputation and died in childbirth at 32, and that was in the 1700's... no it was in the 17th century, and you know we have come a long way in medicine since those days. If we can use the medical knowledge for the third world, solve the medical problems there, solve the problem of the burgeoning population that would result if one just solves medical problems without also dealing with contraception. One could really enormously improve the lot of people all over the surface of the earth. Use the agricultural knowledge to produce enough food so that people don't starve, use techniques for dissolumnation to provide enough water, there is no end to what one can do. If one spent any money on developing alternative energy sources or one could solve the energy problems of some of the emerging nations. If we stop spending obscene amounts of money on the military, to defend against something that never was the threat it was claimed to be, and certainly now isn't even claimed to be such a threat anymore, there'll be a lot of money to do other things. Including eliminating the budget deficit in the US that's going to burden my children for all of their lives. And technology has the possibility of doing all these things. But it hinges on political and social policy that makes it possible to use technology for good things, rather than for things that are detrimental to the world. ---

KISTIAKOSKY 48A Antonello: Can you talk about the decision to drop the bombs?

00: 11: 20: 21 My father was George Kistiakosky who was the head of division x at Los Alamos that built the implosion device that was used in the...actually that division built all of the implosion devices but he personally was responsible for the implosion device that set off

the bomb at A La Magordo, and the one at Nagasaki. The Hiroshima bomb was a different device that was designed and built by somebody else. And so I have a very direct family connection with this event. I went to Los Alamos but just as a teenaged.. young teenaged visiter. And it is very hard to understand in this day and age how one could have used those bombs to kill that large mass of innocent people in Japan. It was done in the context of a war effort to eliminate people who had ceased to be people, they had been depersonified. They had become, you know the Nazis who were in Europe who were uniformly big, brutish and cruel. And the Japs in the Pacific area who were small, yellow and cruel. And they were not human beings to the American public anymore, they were an enemy to be conquered.

00: 13: 05: 22 And let me say there was good reason for wanting to win that war, both with respect to Germany and with respect to Japan. And what one says about the propaganda, it's easy to look back in time and describe it as I do now, but at the time it was part of a heroic war effort, that, not everybody but most of the US was engaged in. There were scientists at the time who tried very hard not to have the bombs used, but not all of the scientists. Oppenheimer for example, the head of Los Alamos, did not oppose to using the bombs in Japan. And the arguement was given that if you could really convince the Japanese to surrender then there would not be a need for an invasion, and more loss of American life. You know one can argue one could of done the same thing by blowing up a vacant island or something like that. But you can't go back and redo the experiment.

00: 14: 22: 20 I think it was the wrong thing to do, and I think in the end my father had very serious doubts about that being the right thing to do. He never was one of the proponents of doing it, he was essentially apolitical in those days, although he ended his life as a very political person. The last twenty years of his life was in opposition to the arms race, having spent the third twenty years of his life, as what he called a weaponeer, his fourth twenty years was as a peace advocate. And it was a reaction to what he had learned while he was in government service, in particular while he was science advisor to President Eisenhower. He discovered how untrue the things were that were told to the public, and even to officials when the government by intelligence and by the military and basically a lot of the policies

had been based on untruths about the Soviet Union. And from that day on he never took at face value a statement from those sources that something was true, he always questioned it. And the result was that through the questioning he resigned all of his government jobs, but they weren't jobs anymore they were just committee memberships. In I guess it was 68, so that he could speak out against the Viet Nam war and that is what he did for the end of his life. ---

KISTIAKOSKY 48A Antonello: Did the racism against the Japanese make the decision to drop the bomb easier?

00: 16: 25: 21 Oh I think it certainly did, just in the same way that President Bush's remark about President Ortega being a little man, is symptomatic of brushing away the Nicaraguans. It is just saying these are you know, essentially nonpeople, they're right to send the contras in and kill them they just are something we don't have to worry about. It's the principle that counts, not the individual lives there. ---

KISTIAKOSKY 48A Antonello: Did you ever discuss the financial investment in the making of the bomb with your father?

00: 17: 31: 21 I never asked him that question, but certainly it is true that any program has its momentum once you set a weapons program in motion, it is very hard to stop it. And even if its demonstrated that the weapon is useless or nonfunctional. I'm sur that added to the reason for using it and you know, a perverted kind of national glory. Look at the wonderful power we have created here, let's by all means demonstrate to the world how powerful we are. I'm sure in some people's minds that also was important. And I believe, although I don't know this, remember this accurately, there was also in a sense a feeling that this might be used to control Stalin. The fact that the US in fact had a weapon of this magnitude, and I believe some people had even suggested that two cities were decimated was done less because of the Japanese than because it was a good idea to demonstrate to Stalin that the US had more than one of these bombs. But this is a memory of something that I read many years ago and it may in fact not be a very accurate representation.

00: 19: 11: 11 I'm sure there were all kinds of things coming coming together in that, in that decision, and depending on which participants to the decision you talk to, you would get a different reading on what the reasons were. ---

KISTIAKOSKY 48A Antonello: Was it your father's choice that you didn't live at Los Alamos?

00: 19: 34: 23 No I went to college, I went to college when I was 15, so I went and spent the summer of my 15th year at Los Alamos, and then I went off to college, and then I came back for my 16th summer, and then went to college again. My father and mother were divorced, and previously to that I had been living with my mother and her second husband in Pittsburgh.