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29A
00:06:19:15 Minsky's hands playing keyboard

Antonello: Can you tell us something about artificial intelligence?

00:11:13:23 Artificial Intelligence..Well the problem is what is intelligence? And..I think that what we are very huge computers, very complicated machines ..that took a very long time to evolve. hundreds of millions of years ago we were fish and then the fish evolved another 100 million years and became amphibians and became reptiles and 100 million years ago the first mammals began to appear and here we are. And all over this time the brain kept accidentally developing new pieces of machinery. So now inside the head you have maybe a thousand different kinds of computers. They each are good at doing certain things.. they all work together or separately that's what intelligence is. so it's a huge system. The mind the brain is like a little city with hundreds of of different kinds of machinery of agents operating in there. And I think that in the next century for the first time we'll be able to understand how that works and be able to make machines like it.

MINSKY 29A

Antonello: You mean machine like human beings?

00:13:00:05I Yes we'll be able to make machines that think like human beings probably they'll think like other beings too that we have never met. And as we build these machines we'll find that some of them are similar to us and some are very different. It'll be a great adventure meeting these new creatures that we've made and no one can tell what they'll do today.

MINSKY 29A

Antonello: people have the idea of robots along the lines of BLADE RUNNER..

00:13:52:10I Well I think we're at a strange moment in history because

before 1950 we had no understanding of complicated machines at all and now in this 40 or 50 years we've had a compressed development of ideas about machines. And these are changing our ideas about the mind because in 1950 no one had any idea of what could happen in a big machine. When I say big machine uh the brain has a 100 billion cells and each cell is connected to thousands of other cells. So we're talking about a thousand million million parts and no one has any concept of what that can do. In the modern computer there are a few million parts. But in 1950 when computers began they only had hundreds of parts so a computer was not much more complicated than a typewriter or a piano or an ordinary machine like that. But now we're beginning a new phase of history where machines are so complicated we can't understand them just like ourselves. So the old ideas about machines are just not valid anymore.

MINSKY 29A

Antonello: What is the new idea about machines?

00:15:28:24 Well people who study computer science know that there are hundreds and hundreds of new ideas that have no precedent in history. The idea of a computer program with..that uses data to do different kinds of reasoning is quite new, maybe a hundred years old. The idea of a compiler, that's a technical word, um that's a program that writes other programs. You give a compiler some instructions about a new program and then it produces the new program. And none of the machines of the past, none of the automobiles, radios or mechanical clocks ever did anything like that. So we have to understand the new ideas. That's the kind of thing that humans do. A person gets some ideas from other people and then somehow rearranges them to create a new idea in the head. And that's the kind of thing the machines in the future will do.

MINSKY 29A

Antonello: Why do you think people have always been afraid of intelligent machines?

00:16:54:01 Well I think people are afraid of intelligent machines for the same reason that people are afraid of intelligent people. Because they are too complicated to predict. You don't know when you meet another person, a person who is very smart and knows many things, then you can't tell what they'll do because your own mind cannot

anticipate it. So I think it's a very human thing to be afraid of something very new. In fact, I'm afraid that people are not enough afraid of Artificial Intelligence because most people don't believe that it's possible.

MINSKY 29A

Antonello: Do you believe that it's possible?

00:17:36:01 Yes, I don't see any reason why we cannot repeat and in a much shorter time the kind of evolution that happened to our ancestors in a very long time. Because in evolution, in nature everything is accident and there's no plan to it, things go from moment to moment but with smart engineers and scientists the evolution of machines will go much faster because we won't have to try so many things that won't work.

MINSKY 29A

Antonello: Can you tell me something about the relationship between science and technology?

00:18:27:00 Well I think science is different from other kinds of human activities because it is cumulative. Scientific discoveries are confirmed somebody has an idea about how something might work..then hundreds of other scientists argue about it. Then do experiments and they test it. And the things that stay in science are the things that we can repeat reliably and so those never go away. In other human affairs if you have some idea about a social organization, you can't do the type of experiments that scientists can do to see what are its results and consequences and how it works. And so progress in most human affairs is not a very clear thing.. You go in different directions and there is no continual advance. In the literature of ancient Greece is in many ways as a advanced as literature in modern countries we see that the architecture perhaps in different periods are different but we can't say that one is better than the other. But in science the knowledge the continues to grow and very little is lost as this happens so I think the history of science is very different from all other kinds of history. In technology when you learn how to do something it usually remains sometimes you have a situation where a certain person can make certain things and no one else can do the same thing. But in technology that's very rare.

MINSKY 29A

Antonello: What is the interchange between science and technology?

00:20:40:01 I don't think there's a clear difference.. In all of science and technology you have people who are doing experiments and remembering what happened and writing it down and telling other people. And in what we call technology new things are learned and other people make new theories to explain them and uh there's that kind of progress. But I don't see that science and technology have any natural boundary. They're parts of the same activity of learning to control the world. Learning to understand the world you might call science and learning to control the world you might call technology but one thing we've learned from computers is that knowledge and using knowledge are not always so different. They're two parts of the same thing. You can't separate facts from the way you think about the facts. Because thinking also means knowledge about how to think. Not just knowledge about the problems you're solving.

MINSKY 29A

Antonello: What are the social implications of Artificial Intelligence?

00:22:20:04 I It's very hard to talk about the effects of certain kinds of developments. Some things are easier than others. If you develop a faster way to travel than you can make some predictions. You might say people can live further from the city or people will have more time for work because they travel so fast. And you can make simple arguments like that. Or people couldBut there are other kind of discoveries that are so drastic so sweeping that you can't predict what will happen and Artificial Intelligence is that kind. With AI there will be other things in the world that are smart and that affects everything. It means that for example no one would have to work. If we have intelligent robots we could make them do all the work and the whole nature of human activity could change. And perhaps most people would simply be consumers of entertainment. Perhaps they would become so discouraged they would find life intolerable.. who knows. It's too large a change to make judgements about.

MINSKY 29A

Antonello: up to today smart machines, robots were used to deskill people..

00:24:44:17| Well eventually automatic factories will be easy to make if AI proceeds and then the problem of capitalism and economics will change because um essentially the production of goods will be very inexpensive and social organizations will have to find ways to distribute these very inexpensive products. No one has ever really faced the question of what to do when everyone could be wealthy.

MINSKY 29A

Antonello: Do you believe there is such a possibility?

00:26:04:07| There certainly is the possibility that machines could make everything that people need. Of course the planet has a certain size and one difficulty is that there might be too many people. There are already too many people. Most of my friends feel and so we have a social problem which has to be solved of how to reduce the population or at least prevent it from growing any further. But that's another subject and I'd like to see more people try to understand that kind of problem. Because the benefits of robots can be erased if the world gets too crowded.

MINSKY 29A

Antonello: Do you think the idea of time changed with the electronic/computer revolution?

00:27:09:19| Well...friends who study history tell me that different cultures have different ideas of time. I'm sure that the presence of new ideas and new technologies changes our way of feeling about time. One aspect of that is we're used to living a certain time and dying and that must have some effect on how we think of every day. Because you know that you have only a limited number of days. I don't think that people think about that all the time, most people don't. But as science progresses in the next hundred or thousand years we'll probably be able to prevent aging and so that we'll have another problem with not only will there be too many people but people who are living need never die. I think robotics will have an effect on this...some day in the next century of starting to understand why some of the cells in the body cannot repair themselves There's so much progress in biology now that we can expect people to live much longer after a certain point. And then they'll think about time differently.

MINSKY 29A

Antonello: Do you think that technology is a deterministic force in history?

00:29:00:18 I don't know what to think about history..to me history is partly driven by accidents and partly driven by ideas. What happens is a new idea appears..a community develops a new way of thinking and it spreads like a disease to other people... and everyone in a hundred years think in a different way. I think to understand history you have to understand this mechanism of how a new way of thinking goes from one person to another and spreads. Now, I think technology and scientific ideas change peoples' thinking to some extent but most people in the world don't understand those ideas and they haven't spread very far so I don't think that technical thinking or scientific thinking is very widespread yet. It's not part of our everyday ordinary way of thinking.

MINSKY 29A

Antonello: Do you think that computer science is the most important innovation in this century?

00:30:27:09 I think that computer science is the most important...has brought the most important new ideas for understanding humans. If you accept my belief that the brain is a machine an immensely complicated machine than maybe the ideas of computer science, the ideas about machines will help us understand how minds work in a new way. And this has not happened yet. But I expect over the next hundred years first the science of psychology will change. And its already changed a lot. There's a new field part of psychology called cognitive psychology which is different from social psychology and psycho-analytic psychology and all the old kinds. And in the US I think its become the most popular part of psychology. Many students are studying the new ideas between the computer science and animal behavior for example. So I think this is a change in history and over the next century the new ideas about programs and new processes and memories and data structures and knowledge represented in computers will move into psychology and produce a new generation of people who think in a new way about other people.

MINSKY 30A

00:00:45:13 Minsky playing briefly w keyboard.

00:01:18:12

Order and disorder, well another change that came with computers is that the word mechanical, the idea of machines has to change now. Because in the first industrial revolution, what did we expect from a machine? You would expect a machine that would do the same thing all day. And it would make objects that were all the same, we call it mass production, interchangeable parts, everything that the machine does is perfect and identical. And that's what has to happen with a simple machine. But we're about to come into a new age, and we see it a little bit in one place or another, but I don't think people are prepared for this difference. What is the difference? That the factory with intelligent robots will not be mass production, each thing that it manufactures can be different. Perhaps the, if you want a new chair or a new shirt, you talk to the machine, and it interviews you. It reads your biography and looks at your house, and then the automatic factory makes a chair just for you. And if you're wide it makes the chair a little bit wider. And if you're tall, maybe a little bit further from the floor. And your clothes will fit perfectly as though you had a good tailor. And everything becomes individual.

00:02:52:14 So the third industrial, I don't know what industrial revolution it is, I mean these things are not continuous, but the factories of the future with the automatic machines, will much more human. They'll make things exactly or as close to what you want, as you like. And if you don't like something you say change it a little bit. Make this bend up. So we're going to move out of the machine age with the new machines. And everything will be different.

Antonello: Do you think society will be better because of this? What do you think about society?

00:03:32:23Ì Well it's a wonderful question, would people like to have individual products made just for them? I think in the culture that I know, people wouldn't like that so much. Most people are afraid to be different, they want to have exactly the same thing that the neighbor has. And perhaps people who were unhappy in the days before machines because each thing had to be crafted personally, and individually. But I don't know how the culture will go. Some people would like to have a standard product, exactly the same as the other people. And be a very close culture where each person knows exactly what the other person does. And things are very uniform. But I think in every culture there are always some individuals who want to be different. These people become isolated or they become leaders, they are at the fringe of the society.

I think anarchists and liberals like the idea that everyone should be different. And encourage people to be original, and creative, and divergent. But I suspect that most people find that unpleasant. If you do something different you have to justify it, you might feel a little less secure than if you do the same thing that everyone else does.

But I think in the next century this possibility will be available and everyone can have custom made things. And custom made newspapers, and magazines and books. There's no reason we all have to read the same newspaper anymore. We have the wire services and a million writers on the planet. And on my computer network, I can ask to have printed a daily newspaper of articles by people who I respect. And anyone who wants to nowadays, can have individualized journals and newspapers and not have to read a mass produced object.

Antonello: It seem that you have an optimistic vision of the future?

00:05:54:09Ì

I'm optimistic that the range of possibilities that are open to us, are not particularly optimistic about which of these

possibilities will materialize and how will people adapt to them. I see the population problem of the world, and especially the under developed and developing countries as a monstrous problem that we'll have to face. And it may lead to terrible tragedies, famine, disease, but that's another matter. I think science will continue to understand more and more. And psychology will develop and it will become possible for us to make highly individual machines. But I'm not especially optimistic about how the course of world history will move to use these possibilities.

MINSKY 30A

Antonello: Do you think the use of technology to increase the profits of capitalism will change with the new turn of events in Eastern Europe?

00:08:20:02 I think that trend changed in the US, in the sense that, the number of working hours decreased. When I was a child, people worked six days a week. Now most people work about three and a half days a week, and pretend to work five days. So we have a forty hour week, and that's going to change to thirty and twenty. It seems to me that the issue of profit is another matter.

Many of the western capitalist states, have underclasses of very poorly paid workers or unemployed workers. You see there's almost no difference there. The problem is what you do to bring people into the culture, and if the culture is based on human effort in manufacturing in production, then I think we're facing a crisis in the end as automation becomes more practical.

00:09:26:24 I Right now automation doesn't do so much for us, because the robots in factories are not very smart, so they can only do maybe half the work. There's still plenty of jobs for unskilled people. But generally speaking in the US, there aren't enough jobs for unskilled people. And we're coming into a serious problem. I don't have any solution for that. I'd like to see people that have more education than skill and knowledge, but I don't have a clear idea what they should do with that when work is not necessary.

MINSKY 30A

Antonello: What is the relationship between technology and war? Does war bring innovation?

00:10:22:00

Well I think war... is very cruel and it causes much tragedy and hardship. But in the countries that are engaging in the war, aside from the hardship, there is a spirit of accomplishment and purpose. The purpose is completely stupid of course, but in wartime societies begin to feel more directed and more constructive, and more creative and more energetic. So the paradox of war, is that it gives people something to do, and something to live for in societies that don't have a very clear goal in peacetime. So I think that's a serious problem and a serious tragedy, but it is responsible for the advances in science and technology that frequently come when you have a national crisis. It's very strange phenomenon and it's hard to find another way of getting so many people to get involved in creative activity. Tragic as the results may be.

MINSKY 30A

Antonello: Were you talking about the war effort in this country during WWII?

00:11:57:14

Yes I particularly have in mind the organization of the west to fight WW2, and a very widespread sense that any contribution to technology was a positive thing. It certainly produced a huge impulse in the progress of modern technology. But I understand the same thing happens earlier in history. The development of tinned food, comes from the Napoleonic, Napoleon had the problem of feeding the army without the food being spoiled. And he got technologists to find some way of preserving food more easily. And this kind of thing happens in many wars, but of course there are many inventions in peacetime. The development of electricity, which took more than a hundred years from Volta, and Franklin, and Edison, two or three hundred years. That was very slow. The development of radar and that particular part of electronics happened in just four or five years in England and the US and, in Germany during WW2. And that's a development that might have taken fifty years otherwise.

00:14:05:06 But it was almost a religious thing, that there was a spread

of a sense of national purpose and positive accomplishment, which was hard to think, in my experience, that nothing like that ever happened. I was a child when this was going on, but I had the sense that almost everyone I knew was involved in some highly constructive activity. Now I know many people who just don't know why they're alive.

MINSKY 30A

Antonello: Do you think there is a military footprint on society?

00:15:05:01 I can't judge because I'm inside it, and I think the....no I'm not enough of an objective historian to have any feeling about that. I see the imprint of military-like activities everywhere all over the world. I can not myself understand why sports, kicking a ball around, knocking people over, occupies almost a half of all the newspapers in every country that I know. So I think there is a disease, a mental illness infecting the whole world. And it shows itself first in sport, and second in war. And I don't think it's particularly military, I think there's, people have no purpose in life except to win meaningless victories of a physical sort. And we see that everywhere.

And in America I

see another problem over the last twenty years, of an acceptance of superstitions, people want to find something outside of their ordinary reality. They're looking for a purpose, or a meaning to the universe, and so we see so many people interested in astrology and these absurd idea that planets affect their minds and their lives. Completely valueless idea, and yet it's like an epidemic, a plague, it spreads from one brain to another. No young person has the courage to say that's completely false, that's an idea with no value whatever. And we have the belief in extrasensory perception, and unidentified flying visitors from other planets, and so many things like that in the US. I don't know how popular these things are in Europe, I know in the Soviet Union, these superstitions are remarkably popular,

00:17:32:06 and I have the feeling in both the eastern and western cultures, people have a feeling that there something wrong with their own cultures and with their things they've been taught and they're interested in believing anything that's strange and different. It's a very strange phenomenon. But I think the sports example is perhaps the most interesting,

because it's so popular. I think any politician who said maybe this is a bad thing, would be killed within the hour.

00:18:22:01 I ...and the popular music, If you listen to the repetitive rhythms, and the fixed harmony, and the strange words, where they repeats some sexual or depressed idea about life over and over, a hundred times. I wonder what did that do to our minds and why do people listen to that so much and demand more, and pay money and buy machines to play it in their ears, all the time. So I'm not so optimistic about the progression of our culture, it seems to me that it's not just the US but in Europe and the Communist countries, people are very, have very low standards for what they will believe. They don't seem to care what happens to their minds. It's a lack of self respect.

MINSKY 30A

Antonello: With the WWII a new relationship developed between the govt, the military and the universities...

00:20:21:13 I Well I think the universities are more concerned with research, than with education in many cases. And I don't think that this is a bad thing on the whole. It seems to me big science is big because it's ambitious, and there is some problems that require a lot of equipment and a lot of effort to solve. So I don't have any uncomfortable feeling about the change in the university in that respect. Seems to me it's just in the nature of what we have discovered in the last fifty years. That research becomes more expensive. To do physics when I was a child, a few million volts was good enough, and Lawrence built cyclotrons. The first cyclotron was only this big, and it led to many discoveries. Then that got used up and people had to build bigger ones and now we're talking about building, for physics, machines that are a hundred kilometers in size. There's the one at Sern, and the Americans are talking about building one, but they probably won't spend the money because they're so poor.

00:21:44:12 I I think that the corrupting influence of the military industrial complex, is really more in politics. Particularly in the US, you know that each senator and each representative gets reelected both in accordance with the economic prosperity of his region. And each of them concerned with some small part of the US, and so they each must have an expensive military industrial operation in

their district. And you see that means that there are fifty states, so you have to have fifty major factories for political reasons. And there are almost five hundred congressman with separate districts, so each of them has to have some of that defense budget. And this means it's going to be very hard to undo this, just too many vested interests.

00:22:48:10 I And I really don't think the universities are a major part of that problem. But if what's happened in the universities is very positive, and the American research establishment in many ways is a model that the Europeans should look to more carefully. In my laboratory for example, if I know a young professor in some other university who is very good at our subject, I can try to bring him here. And we have a real market of trying to get people who are good in their field to join their group. In Italy or France, a politician comes in between. There's always some minister or some political person who is involved in making the transfer. So you don't have a free market for intellectual talent.

00:23:48:18 I I think maybe we should see more capitalism. I like the capitalism in the American university. And I use capitalism in its metaphorical sense, that people work for incentives. The main incentive for a professor, is to be with other people who are very good, it's not money, it's not equipment, it's to be in the best department in your field. And this is a very powerful incentive, and it makes people do better work, I think.

MINSKY 30A

Antonello: Is what you have just described a reason that the US is no longer able to compete in the marketplace?

00:25:03:12 I I think that's right, because there's another....In the US there is also a very serious competition between the universities and the companies with government funding. Because, this is an economic competition. The defense industries can pay very large amounts of money to the young scholars, and in general they can pay more than the university can. And so in a way civilian science is at a disadvantage because some very good people are attracted. The best engineers are very often attracted to the higher salaries, and those are in the nonproductive defense

industries.

I should add that, in the US we have another problem that I think may be more serious, which is young people getting attracted to high salaries in management and law. And I've had very smart students who could have been great scientists, or good scientists, change and go into business management or legal practice, or advising. Some of our best computer scientists have gone to NY and become investment advisors for Wall Street companies. And again we have a lot of competition between the university science and these other highly paid activities.

00:26:46:18 See people

are worried about the defense budget very much nowadays, but I think if you're going to find something to worry about, maybe you should be even more worried about the legal budget. Because the legal industry is growing in America, at such an exponential rate. The cost of negotiating has grown so high. The cost of producing a new product in the face of liability suits is becoming extremely powerful. And I think one of the reasons US may be losing its productivity is that people are afraid to make a new product, because there are too many lawyers who will find some way to sue about some unpredicted property of these products.

MINSKY 30A

Antonello: What is the society of mind about?

00:27:53:04 The society of mind, is a new theory of psychology. Now it's not entirely new, it's based on ideas that come from as far back as Sigmund Freud, and John Piaget, the Swiss psychologist, and Nico Tenvergen the animal behavior scientist, Conrad Lawrence and many people. But the main idea in a society of mind is a new conception that the mind is not a single thing. Most people think that somewhere in their head there's a little person who makes decisions and controls things. And what I described is what I think is a better idea, that there are many different parts of the brain with different abilities, and different concerns, and that what we call thinking is the activity of a whole community of specialized individuals that do different things. And what we call thinking comes out of this activity, in a very complex way. So it decentralizes, it's a decentralized idea of what thinking is. It gives you new

ways to think about why people believe things and why people act in one way and talk in a different way, and do physical things in yet another way.

MINSKY 30A

Antonello: What does TV do to our mind? What are the social implications of TV?

00:30:00:11 I find it very hard to understand what people imagine themselves to be. You live a certain time, you have a certain number of things you can do, certain ways to develop relationships you can make. And it's so interesting to see that so many people are attracted to doing passive things, to not making any decisions at all, to watching television for a long time, to seeing the same thing that many other people see. It's a very strange thing for me to imagine, and it's the same, I have the same feeling about the popular music. Why do so many people listen to these mass produced noises. It's a strange and distressing phenomenon. But I suspect that there's nothing new about it, and that in most cultures, most people want to do the same thing other people do. And do not want to solve problems and do not want to confront difficulty, and so they like to be entertained and to just sit there and have something keep their mind from functioning. And maybe it's for the best, because if you had a society where everyone were original and creative, it would be hell. Wouldn't it? ,Everytime you spoke to somebody, you would have to change your mind and think about a new hard problem. And most people don't like that.

MINSKY 31A

00:01:07:20 Well we could talk about goals. That's in the society of mind, I talk about the problem of how people learn to think. Because part of the book is about, ideas about how children learn to think, and part is about how adults learn to not think. And I think one of the problems that we have in society is that, we could it the investment principle, that when you have learned a certain way to do things and a certain set of ideas, and then you can live and you can solve all the problems in the same way that you did before, and each day is the same. And now somebody tells you a new

idea, or ask you to learn a new way to think, or a new kind of skill, most people don't like that because it means pain

if you dress a certain way, or if you talk a certain way, or think a certain way, with habits, then it's very hard to do something else and it hurts a little bit and feel uncomfortable, and awkward. People don't like to be uncomfortable. Now the nice thing about science, is that in science it's not all right.

00:02:56:01 If somebody discovers that an old idea is wrong, for example, Einstein discovered that the old ideas that time and space were a little bit wrong. Then over the next twenty years all of the scientists had to change how they think, and it was hard work. And many people didn't like it, but they all learned because they knew that this was an advance. That the experiments showed that Einstein was right, if we were going to understand the world, we would have to take the old way of thinking and change it to the new way. So the scientists had to learn something new and it was very uncomfortable, and painful. But they loved it.

And you see, I think the reason we have progress in science is partly because the experiments force us to accept new truths. But also because the scientist has learned that even if you suffer to learn something new you also enjoy it. And in the society of mind, I talked about the idea that there are many things in the brain, and just when one of them, one of the machines is unhappy or in pain another one can be ecstatic and excited. For me, learning something new is always pleasant even if it hurts, and I don't think we have that idea in most societies and most places.

00:04:41:18 The people watch television to see the same thing, or they read the newspaper, and you know in the ordinary newspaper, it's always the same. Some politician has a scandal, some children are killed in an automobile accident, some fire has destroyed some children. It doesn't matter where in the US, if there were no children killed in America, they'll tell about the bus accident in Bangladesh. But everyday in the news there must be an accident with children and a bus, because people want that and expect it. And they feel a little bit sad, but they like it because they can think the same thought today that they thought yesterday. And maybe that's also the reason for the sports, because, you know I think the thing wrong with sports, it's

all fixed, they all cheat. In every game somebody wins. If two baseball teams play very bad, they should both lose, but that's not permitted. So you see the entertainers arrange it that someone always wins and someone happy. So there's nothing new each day.

00:06:02:03] That's why I think people should learn more about science and skepticism, because the fullest life is when you have pleasure and pain. And the best pain is when you learn that an old idea is bad and you enjoy having a new idea even if it hurts. And that's why I see progress in the sciences, but not so much progress in the other things that people do. Because there there's no one to force you to learn the new things. In science there's nobody in charge and there's no dictator saying you must learn the new thing. But what a scientist does, they train themselves if something is false, if there's something you cannot explain, you are forced to respect it and understand it. So we love mysteries, but we don't want to keep the mysteries. Every mystery is love and hate in the same thing. You cannot ignore the mystery but you must try to remove it. To remove it you must learn something new and make a new theory and get more evidence and do a new experiment. And always you must tell the other people and see if they agree.

00:08:05:05] Well really I think each person lives in several societies. I have as a scientist, I have a society which is international and global. Because I have the friends in every country and the telephone and the computer network, and when there's a discovery we talk. So half of my conversations are long distance, because that's another society that I belong to. Then in the local society each person has the neighbors and the family, it's almost a different person. I know scientist who love sports. I think they change their mind, they switch to another part of the brain, and in that period a different part of the brain is controlling the personality.

What I'm worried is that most people, I think every person has many societies, the society of people in your business, the society of people in your school, the people in your religion and your social group. But most people have no global society at all, nothing that reaches very far from the community that they live in. And so they're a little bit isolated and not forced to grow so much.

Antonello: The rise of marketing and advertising agencies and their control of mass media images.. TV audiences...censorship..

00:11:17:01Ì Yes, I think the existence of rapidly produced mass media, broadcast media, produces a kind of, it's in its nature to produce a kind of censorship. If you have a television program and a budget for advertising that cost, has a large cost, then you have to shape the broadcast to attract the largest number of people, and that means that minorities will not see what they want. And this is been developing I think over the last generation, more and more relentlessly, so that you don't see on television very many unpopular ideas. It's not a free market, it's a highly regulated censored market. Eventhough it's not a dictatorship, but it's people who make polls and studies and market surveys.

00:12:25:12Ì Now another kind of communication medium has appeared in the last ten years, but very few people know about it. This is the special interest bulletin board that we have on a computer network. And if I go over to my terminal and dial a certain telephone number, I can be connected to a network of people all over the world who are interested in the space station. And on that network and sometimes I spend an hour or two, reading the previous messages and sending letters to people that go to all the other people on the network, to talk about how can we design a space station better. I just press another key and I'm connected to a group of about three hundred people who are interested in fission, and new sources of energy. I can press another button and be connected to a network of a few thousand people who collect jokes, and on the computer screen, if I press this button, a hundred jokes will appear. Maybe three new ones and ninety seven old jokes that are just a little bit different.

So we're beginning to see an underground of not broadcast communication, of special purpose networks. It's like a special magazine for just this hundred people. The cost is very low, somebody types and the messages appear on the computer screen of all the other people. Now I like to think that, or I hope that this kind of special interest broadcast medium will replace the mass media to a large extent over the next hundred years. It's already here, and there are perhaps a million people in the US who are, who use these special purpose bulletin boards. If you're interested in fishing, you can talk to a hundred people who are interested

in your kind of fishing. If you like to watch birds, there's a network that tells about where people communicate and leave little stories that they tell about birds that they've seen. There's a Chinese restaurant network, which people use to make reports on new Chinese restaurants and what's the best thing to order.

00:15:04:06] And so we have a new kind of publication, it works all over the world and for example, I'm interested in the logo language. This is a computer language for helping children to learn about computers, and when I talk on this network I can talk to a friend in Argentina, and a friend in London, and a friend in Holland, and communicate with a whole group of people in a sort of public way. I have some friends in Brazil that I would like to talk to but their government doesn't seem to encourage this kind of network, so they don't have access to it, I'm sure there will be progress in that.

00:15:56:09] So I think that it's possible that the broadcast media can be replaced by a more personal media, but the question is how many people will want to do that and what part of the public are interested in developing their own special interests. And to what extent do they want to share the public interests. Most people would like to know the same thing as other people so they can talk about it. So if you know the same news about the same revolution or the same sports game, then it's easy to talk to some other person because you share the same knowledge. With the special interest network you could talk to people in different cities, because only a few people in each city might be interested in the space station or one of these special topics. And you can't use it so much in everyday life with the people that you meet in the store or in the street.

MINSKY 31A

Antonello: Do you consider yourself a scientist?

00:17:19:04] It's hard to, I can't make myself into a category. I think of myself as sometimes a mathematician and sometimes a psychologist and sometimes a physicist, but these words don't communicate very much.

MINSKY 31A

Antonello: Do you believe scientists have a social responsibility in their work?

00:17:54:06 I think each scientist, maybe they have a social responsibility but scientist that I know are not particularly good at making social judgements, and so I think it's my own view is that it's a mistake to expect scientists to be responsible, because they're not good at it. And I think that the best way to control technology and science, is by the usual political process. The scientist who is working on a certain invention is a valuable asset to society, and you should not make his job more difficult by making him feel guilty.

The best thing is to have an opposition group, so we should create enemies for the scientist, it's good to have an organization to try to keep the biologists from developing new biological tools. But we also want to have the biological tools or the knowledge about them, and so you want the biologist to work with his full heart and mind to develop the new techniques. And I don't think it's reasonable to ask the same person to do difficult research and to try to calculate whether the research will be applied to things he doesn't like, or that you don't like.

00:19:42:00 I So I don't think that scientists should be socially responsible, I think the public should be better educated, and know enough to oppose and to stop technology when it gets to a dangerous point. But if you ask the scientist to make this decision, they'll never make the right decision because they're not very good at that kind of thing.

MINSKY 31A

Antonello: Do you see science as neutral?

00:20:16:12 I

I see scientific knowledge as neutral, but I see scientists

as typical irresponsible people, the same as everyone else.

Antonello: How important is music to the process of learning?

00:20:46:19

Well the question of why people make music and why they listen to it, is a serious mystery. And I think that as a scientist I want to understand or to find out why music exist and why it has so much influence on people. No one knows how it works in the brain, and what it's function is. I have a number of theories, but I don't know if they're true. And one theory is that people use music as a trick, music is a little bit like language, and you can use music to affect different parts of your brain without having any meaning. So it may be a trick that's we use to control our minds.

I can play a certain kind of music, and make people feel happy or unhappy. And this could be very useful for social purposes, but nobody knows how it works. It could be very dangerous perhaps, if someone learns to use it for manipulating people to believe things that otherwise they would not believe. In religions for example, it's very common to use musical tricks to convince people to believe the religious statements. And so I think it's important as scientists and psychologist that we understand someday we don't now, how music affects the brain and changes the way people think and believe. I do not think it is healthy to treat music as a pure artistic and positive thing, we should treat it as a strange phenomenon that it would be better to understand, and not treat with great respect.

In fact, I had spent some time practicing to train myself to not like music, and it's quite hard. It's as hard to not like music as to learn to play it or compose it. And I recommend that everybody spend a little time listening to music and saying that's stupid, too many notes, boring repetitive pattern. And in this way you might get some insight into why music has such strong affects on you. We should not treat it as a simple obvious thing.

Antonello: Do you think the same applies to film and television?

00:23:56:09 I don't think images work the same way as sound, they are processed and affect different parts of the brain. And of course there are some interaction when you hear a sound, in one part of your brain it may cause some kind of images in another part and visa-versa. But I think we need another fifty or hundred years of brain science to develop before we will understand this very well. To me this is a very exciting moment in history, because we are just beginning to have some ideas as how the brain works. And to me everything in the past is just superstition. Everything about psychology, everything about art, language, music, humor, all these things that people do, and I look forward every year to finding hundreds of new truths about how different kinds of ideas work in different parts of the brain and change how we think.

MINSKY 31A

Antonello: Can we understand more about the workings of the brain because of the computer?

00:25:17:24

I think that it's because of the development of ideas that complicated machines and computers, that started in the middle 1950's, that we are now able to imagine theories of how the brain works for the first time. And so this is going to change all philosophy and all psychology in the future. Because there really are very many new ideas in computer science. Ideas that nobody has ever thought before, wonderful ideas about the nature of knowledge, the nature of language. The structure of reasoning, how new ideas are made from old ideas, and just completely new collection of concepts about how minds work, have come in the last forty or fifty years. And it's only the beginning. I can't imagine this flood of new ideas growing like a population explosion, stopping or slowing down for the next fifty years. Beyond fifty years no one can predict,

00:26:37:19 computer science is increasing in depth and power every year, enough that the student who studies for four years the ideas in computer science and then graduates, now has to go back to school. Because the four year old ideas are obsolete already.

Maybe...., there are two sciences today that are changing very rapidly, one is genetics and biology and the other is computer science. And truly in these fields to be an expert, you have to go back to school every three or four years. It's very painful and very glorious.

Because there are so many new ideas that make the old ideas seem childish and unimportant.

(same tape, TC must have accidentally been changed)

00:00:54:22Ì Minsky playing the keyboard

00:05:03:08Ì wide of room w Minsky playing keyboard

00:08:37:07Ì tape ends w Minsky playing keyboard

MINSKY 32A

00:08:50:24Ì B-roll art objects in Minsky's house

le like to have individual products made just for them? I think in the culture that I know, people wouldn't like that so much. Most people are afraid to be different, they want to have exactly the same thing that the neighbor has. And perhaps people were unhappy in the days before machines because each thing had to be crafted personally, and individually. But I don't know how the culture will go. Some people would like to have a standard product, exactly the same as the other people. And be a very close culture where each person knows exactly what the other person does. And things are very uniform. But I think in every culture there are always some individuals who want to be different. These people become isolated or they become leaders, they are at the fringe of the society. I think anarchists and liberals like the idea that everyone should be different. And encourage people to be original, and creative, and divergent. But I suspect that most people find that unpleasant. If you do something different you have to justify it, you might feel a little less secure than if you do the same thing that everyone else does. But I think in the next century this possibility will be available and everyone can have custom made things. And custom made newspapers, and magazines and books. There's no reason we all have to read the same newspaper anymore. We have the

wire services and a million writers on the planet . And on my computer network, I can ask to have printed a daily newspaper of articles by people who I respect. And anyone who wants to nowadays, can have individualized journals and newspapers and not have to read a mass produced object.

I'm optimistic that the range of possibilities that are open to us, are not particularly optimistic about which of these possibilities will materialize and how will people adapt to them. I see the population problem of the world, and especially the under developed and developing countries as a monstrous problem that we'll have to face. And it may lead to terrible tragedies, famine, disease, but that's another matter. I think science will continue to understand more and more. And psychology will develop and it will become possible for us to make highly individual machines. But I'm not especially optimistic about how the course of world history will move to use these possibilities.

I think that trend changed in the US, in the sense that, the number of working hours decreased. When I was a child, people worked six days a week. Now most people work about three and a half days a week, and pretend to work five days. So we have a forty hour week, and that's going to change to thirty and twenty. It seems to me that the issue of profit is another matter. Many of the western capitalist states, have underclasses of very poorly paid workers or unemployed workers. You see there's almost no difference there. The problem is what you do to bring people into the culture, and if the culture is based on human effort in manufacturing in production, then I think we're facing a crisis in the end as automation becomes more practical. Right now automation doesn't do so much for us, because the robots in factories are not very smart, so they can only do maybe half the work. There's still plenty of jobs for unskilled people. But generally speaking in the US, there aren't enough jobs for unskilled people. And we're coming into a serious problem. I don't have any solution for that. I'd like to see people that have more education than skill and knowledge, but I don't have a clear idea what they should do with that when work is not necessary.

Well I think war is very cruel and it causes much tragedy and hardship. But in the countries that are engaging in the war, aside from the hardship, there is a spirit of accomplishment and purpose. The purpose is completely stupid of course, but in wartime societies begin to feel more directed and more constructive, and more creative and more energetic. So the paradox of war, is that it gives people something to do, and something to live for in societies that don't have a very clear goal in peacetime. So I think that's

a serious problem and a serious tragedy, but it is responsible for the advances in science and technology that frequently come when you have a national crisis. It's very strange phenomenon and it's hard to find another way of getting so many people to get involved in creative activity. Tragic as the results may be.

Yes I particularly have in mind the organization of the west to fight WW2, and a very widespread sense that any contribution to technology was a positive thing. It certainly produced a huge impulse in the progress of modern technology. But I understand the same thing happens earlier in history. The development of tinned food, comes from the Napoleonic, Napoleon had the problem of feeding the army without the food being spoiled. And he got technologists to find some way of preserving food more easily. And this kind of thing happens in many wars, but of course there are many inventions in peacetime. The development of electricity, which took more than a hundred years from Volta, and Franklin, and Edison, who were three hundred years. That was very slow. The development of radar and that particular part of electronics happened in just four or five years in England and the US and, in Germany during WW2. And that's a development that might have taken fifty years otherwise. But it was almost a religious thing, that there was a spread of a sense of national purpose and positive accomplishment, which was hard to think, in my experience, that like that ever happened. I was a child when this was going on, but I had the sense that almost everyone I knew was involved in some highly constructive activity. Now I know many people who just don't know why they're alive.

I can't judge because I'm inside it, and I think the.....no I'm not enough of an objective historian to have any feeling about that. I see the imprint of military-like activities everywhere all over the world. I can not myself understand why sports, kicking a ball around, knocking people over, occupies almost a half of all the newspapers in every country that I know. So I think there is a disease, a mental illness infecting the whole world. And it shows itself first in sport, and second in war. And I don't think it's particularly military, I think there's, people have no purpose in life except to win meaningless victories of a physical sort. And we see that everywhere. And in America I see another problem over the last twenty years, of an acceptance of superstitions, people want to find something outside of their ordinary reality. They're looking for a purpose, or a meaning to the universe, and so we see so many people interested in astrology and these absurd idea that planets affect their minds and their lives. Completely

valueless idea, and yet it's like an epidemic, a plague, it spreads from one brain to another. No young person has the courage to say that's completely false, that's an idea with no value whatever. And we have the belief in extrasensory perception, and unidentified flying visitors from other planets, and so many things like that in the US. I don't know how popular these things are in Europe, I know in the Soviet Union, these superstitions are remarkably popular, and I have the feeling in both the eastern and western cultures, people have a feeling that there something wrong with their own cultures and with their things they've been taught and they're interested in believing anything that's strange and different. It's a very strange phenomenon. But I think the sports example is perhaps the most interesting, because it's so popular. I think any politician who said maybe this is a bad thing, would be killed within the hour. ...and the popular music, If you listen to the repetitive rythms, and the fixed harmony, and the strange words, where they repeats some sexual or depressed idea about life over and over, a hundred times. I wonder what did that do to our minds and why do people listen to that so much and demand more, and pay money and buy machines to play it in their ears, all the time. So I'm not so optimistic about the progression of our culture, it seems to me that it's not just the US but in Europe and the Communist countries, people are very, have very low standards for what they will believe. They don't seem to care what happens to their minds. It's a lack of self respect.

Well I think the universities are more concerned with research, than with education in many cases. And I don't think that this is a bad thing on the whole. It seems to me big science is big because it's abitious, and there is some problems that require a lot of equipment and a lot of effort to solve. So I don't have any uncomfortable feeling about the change in the university in that respect. Seems to me it's just in the nature of what we have discovered in the last fifty years. That research becomes more expensive. To do physics when I was a child, a few million volts was good enough, and Lwrence built cyclotrons. The first cyclotron was only this big, and it led to many discoveries. Then that got used up and people had to build bigger ones and now we're talking about building, for physics, machines that are a hundred kilometers in size. There's the one at Sern, and the Americans are talking about building one, but they probably won't spend the money because they're so poor. I think that the corrupting influence on the military industrial complex, is really more in politics. Particularly in the US, you know that each senator and each

representative gets reelected both in accordance with the economic prosperity of his region. And each of them concerned with some small part of the US, and so they each must have an expensive military industrial operation in their district. And you see that means that there are fifty states, so you have to have fifty major factories for political reasons. And there are almost five hundred congressman with separate districts, so each of them has to have some of that defense budget. And this means it's going to be very hard to undo this, just too many vested interests. And I really don't think the universities are a major part of that problem. But if what's happened in the universities is very positive, and the American research establishment in many ways is a model that the Europeans should look to more carefully. In my laboratory for example, if I know a young professor in some other university who is very good at our subject, I can try to bring him here. And we have a real market of trying to get people who are good in their field to join their group. In Italy or France, a politician comes in between. There's always some minister or some political person who is involved in making the transfer. So you don't have a free market for intellectual talent. I think maybe we should see more capitalism. I like the capitalism in the American university. And I use capitalism in it's metaphorical sense, that people work for incentives. The main incentive for a professor, is to be with other people who are very good, it's not money, it's not equipment, it's to be in the best department in your field. And this is a very powerful incentive, and it makes people do better work, I think.

I think that 's right, because there's another.....In the US there is also a very serious competition between the universities and the companies with government funding. Because, this is an economic competition. The defense industries can pay very large amounts of money to the young scholars, and in general they can pay more than the university can. And so in a way civilian science is at a disadvantage because some very good people are attracted. The best engineers are very often attracted to the higher salaries, and those are in the nonproductive defense industries. I should add that, in the US we have another problem that I think may be more serious, which is young people getting attracted to high salaries in m,management and law. And I've had very smart students who could have been great scientists, or good scientists, change and go into business management or legal practice, or advising. Some of our best computer scientists have gone to NY and become investment advisors for Wall Street companies. And

again we have a lot of competition between the university science and these other highly paid activities. See people are worried about the defense budget very much nowadays, but I think if you're going to find something to worry about, maybe you should be even more worried about the legal budget. Because the legal industry is growing in America, at such an exponential rate. The cost of negotiating has grown so high. The cost of producing a new product in the face of liability suits is becoming extremely powerful. And I think one of the reasons US may be losing its productivity is that people are afraid to make a new product, because there are too many lawyers who will find some way to sue about some unpredicted property of these products.

The society of mind, is a new theory of psychology. Now it's not entirely new, it's based on ideas that come from as far back as Sigmund Freud, and John Piaget, the Swiss psychologist, and Nico Tinbergen the animal behavior scientist, Conrad Lawrence and many people. But the main idea in a society of mind is a new conception that the mind is not a single thing. Most people think that somewhere in their head there's a little person who makes decisions and controls things. And what I described is what I think is a better idea, that there are many different parts of the brain with different abilities, and different concerns, and that what we call thinking is the activity of a whole community of specialized individuals that do different things. And what we call thinking comes out of this activity, in a very complex way. So it decentralizes, it's a decentralized idea of what thinking is. It gives you new ways to think about why people believe things and why people act in one way and talk in a different way, and do physical things in yet another way.

I find it very hard to understand what people imagine themselves to be. You live a certain time, you have a certain number of things you can do, certain ways to develop relationships you can make. And it's so interesting to see that so many people are attracted to doing passive things, to not making any decisions at all, to watching television for a long time. Seeing the same thing that many other people see. It's a very strange thing for me to imagine, and it's the same, I have the same feeling about the popular music. Why do so many people listen to these mass produced noises. It's a strange and distressing phenomenon. But I suspect that there's nothing new about it, and that in most cultures, most people want to do the same thing other people do. And do not want to solve problems and do not want to confront difficulty, and so they like to be entertained and to just sit there and have something keep their mind from

functioning. And maybe it's for the best, because if you had a society where everyone were original and creative, it would be hell. Wouldn't it? Everytime you spoke to somebody, you would have to change your mind and think about a new hard problem. And most people don't like that.

Well we could talk about goals. That's in the society of mind, I talk about the problem of how people learn to think. Because part of the book is about, ideas about how children learn to think, and part is about how adults learn to not think. And I think one of the problems that we have in society is that, we could it the investment principle, that when you have learned a certain way to do things and a certain set of ideas, and then you can live and you can solve all the problems in the same way that you did before, and each day is the same. And now somebody tells you a new idea, or ask you to learn a new way to think, or a new kind of skill, most people don't like that because it means pain if you dress a certain way, or if you talk a certain way, or think a certain way, with habits, then it's very hard to do something else and it hurts a little bit and feel uncomfortable, and awkward. People don't like to be uncomfortable. Now the nice thing about science, is that in science it's not all right. If somebody discovers that an old idea is wrong, for example, Einstein discovered that the old ideas at that time and space were a little bit wrong. Then over the next twenty years all of the scientists had to change how they think, and it was hard work. And many people didn't like it, but they all learned because they knew that this was an advance. That the experiments showed that Einstein was right, if we were going to understand the world, we would have to take the old way of thinking and change it to the new way. So the scientists had to learn something new and it was very uncomfortable, and painful. But they loved it. And you see, I think the reason we have progress in science is partly because the experiments force us to accept new truths. But also because the scientist has learned that even if you suffer to learn something new you also enjoy it. And in the society of mind, I talked about the idea that there are many things in the brain, and just when one of them, one of the machines is unhappy or in pain another one can be estatic and excited. For me, learning something new is always pleasant even if it hurts, and I don't think we have that idea in most societies and most places. The people watch television to see the same thing, or they read the newspaper, and you know in the ordinary newspaper, it's always the same. Some politician has a scandal, some children are killed in an automobile

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w_&9G_r_+ÄÜ" in the news there must be an accident with children and a bus, because people want that and expect it. And they feel a little bit sad, but they like it because they can think the same thought today that they thought yesterday. And maybe that's also the reason for the sports, because, you know I think the thing wrong with sports, it's all fixed, they all cheat. In every game somebody wins. If two baseball teams play very bad, they should both lose, but that's not permitted. So you see the entertainers arrange it that someone always wins and someone happy. So there's nothing new each day. That's why I think people should learn more about science and skepticism, because the fullest life is when you have pleasure and pain. And the best pain is when you learn that an old idea is bad and you enjoy having a new idea even if it hurts. And that's why I see progress in the sciences, but not so much progress in the other things that people do. Because there there's no one to force you to learn the new things. In science there's nobody in charge and there's no dictator saying you must learn the new thing. But what a scientist does, they train themselves if something is false, if there's something you cannot explain, you are forced to respect it and understand it. So we love mysteries, but we don't want to keep the mysteries. Every mystery is love and hate in the same thing. You cannot ignore the mystery but you must try to remove it. To remove it you must learn something new and make a new theory and get more evidence and do a new experiment. And always you must tell the other people and see if they agree.

Well really I think each person lives in several societies. I have as a scientist, I have a society which is international and global. Because I have the friends in every country and the telephone and the computer network, and when there's a discovery we talk. So half of my conversations are long distance, because that's another society that I belong to. Then in the local society each person has the neighbors and the family, it's almost a different person. I know scientist who love sports. I think they change their mind, they switch to another part of the brain, and in that period a different part of the brain is controlling the personality. What I'm worried is that most people, I think every person has many societies, the society of people in your business, the society of people in your school, the people in your religion and your social group. But most people have no global society at all, nothing that reaches very far from the community that they live in. And so they're a little bit isolated and not forced to grow so much.

Yes, I think the existence of rapidly produced mass media, broadcast media, produces a kind of, it's in its nature to

produce a kind of censorship. If you have a television program and a budget for advertising that cost, has a large cost, then you have to shape the broadcast to attract the largest number of people, and that means that minorities will not see what they want. And this is been developing I think over the last generation, more and more relentlessly, so that you don't see on television very many unpopular ideas. It's not a free market, it's a highly regulated censored market. Eventhough it's not a dictatorship, but it's people who make polls and studies and market surveys. Now another kind of communication medium has appeared in the last ten years, but very few people know about it. This is the special interest bulletin board that we have on a computer network. And if I go over to my terminal and dial a certain telephone number, I can be connected to a network of people all over the world who are interested in the space station. And on that network and sometimes I spend an hour or two, reading the previous messages and sending letters to people that go to all the other people on the set, to talk about how can we design a space station better. I just press another key and I'm connected to a group of about three hundred people who are interested in fission, and new sources of energy. I can press another button and be connected to a network of a few thousand people who collect jokes, and on the computer screen, if I press this button, a hundred jokes will appear. Maybe three new ones and ninety seven old jokes that are just a little bit different. So we're beginning to see an underground of not broadcast communication, of special purpose networks. It's like a special magazine for just this hundred people. The cost is very low, somebody types and the messages appear on the computer screen of all the other people. Now I like to think that, or I hope that this kind of special interest broadcast medium will replace the mass media to a large extent over the next hundred years. It's already here, and there are perhaps a million people in the US who are, who use these special purpose bulletin boards. If you're interested in fishing, you can talk to a hundred people who are interested in your kind of fishing. If you like to watch birds, there's a network that tells about where people communicate and leave little stories that they tell about birds that they've seen. There's a Chinese restaurant network, which people use to make reports on new Chinese restaurants and what's the best thing to order. And so we have a new kind of publication, it works all over the world and for example, I'm interested in the logo language. This is a computer language for helping children learn about computers, and when I talk on this network I can talk to a friend in

Argentina, and a friend in London, and a friend in Holland, and communicate with a whole group of people in a sort of public way. I have some friends in Brazil that I would like to talk to but their government doesn't seem to encourage this kind of network, so they don't have access to it, I'm sure there will be progress in that. So I think that it's possible that the broadcast media can be replaced by a more personal media, but the question is how many people will want to do that and what part of the public are interested in developing their own special interests. And to what extent do they want to share the public interests. Most people would like to know the same thing as other people so they can talk about it. So if you know the same news about the same revolution or the same sports game, then it's easy to talk to some other person because you share the same knowledge. With the special interest network you could talk to people in different cities, because only a few people in each city might be interested in the space station or one of these special topics. And you can't use it so much in everyday life with the people that you meet in the store or in the street.

It's hard to, I can't make myself into a category. I think of myself as sometimes a mathematician and sometimes a psychologist and sometimes a physicist, but these words don't communicate very much.

I think each scientist, maybe they have a social responsibility but scientist that I know are not particularly good at making social judgements, and so I think it's my own view is that it's a mistake to expect scientists to be responsible, because they're not good at it. And I think that the best way to control technology and science, is by the usual political process. The scientist who is working on a certain invention is a valuable asset to society, and you should not make his job more difficult by making him feel guilty. The best thing is to have an opposition group, so we should create enemies for the scientist, it's good to have an organization to try to keep the biologists from developing new biological tools. But we also want to have the biological tools or the knowledge about them, and so you want the biologist to work with his full heart and mind to develop the new techniques. And I don't think it's reasonable to ask the same person to do difficult research and to try to calculate whether the research will be applied to things he doesn't like, or that you don't like. So I don't think that scientists should be socially responsible, I think the public should be better educated, and know enough to oppose and to stop technology when it gets to a dangerous point. But if you ask the

scientist to make this decision, they'll never make the right decision because they're not very good at that kind of thing.

I see scientific knowledge as neutral, but I see scientists as typical irresponsible people, the same as everyone else.

Well the question of why people make music and why they listen to it, is a serious mystery. And I think that as a scientist I want to understand or to find out why music exist and why it has so much influence on people. Noone knows how it works in the brain, and what it's function is.

I have a number of theories, but I don't know if they're true. And one theory is that people use music as a trick, music is a little bit like language, and you can use music to affect different parts of your brain without having any meaning. So it may be a trick that's been used to control our minds. I can play a certain kind of music, and make people feel happy or unhappy. And this could be very useful for social purposes, but nobody knows how it works. It could be very dangerous perhaps, if someone learns to use it for manipulating people to believe things that otherwise they would not believe. In religions for example, it's very common to use musical tricks to convince people to believe the religious statements. And so I think it's important as scientists and psychologist that we understand someday we don't now, how music affects the brain and changes the way people think and believe. I do not think it is healthy to treat music as a pure artistic and positive thing, we should treat it as a strange phenomenon that it would be better to understand, and not treat with great respect. In fact, I had spent some time practicing to train myself to not like music, and it's quite hard. It's as hard to not like music as to learn to play it or compose it. And I recommend that everybody spend a little time listening to music and saying that's stupid, too many notes, boring repetitive pattern.

And in this way you might get some insight into why music has such strong affects on you. We should not treat it as a simple obvious thing.

I don't think images work the same way as sound, they are processed and affect different parts of the brain. And of course there are some interaction when you hear a sound, in one part of your brain it may cause some kind of images in another part and visa-versa. But I think we need another fifty or hundred years of brain science to develop before we will understand it very well. To me this is a very exciting moment in history, because we are just beginning to have some ideas as how the brain works. And to me everything in the past is just superstition. Everything about psychology, everything about art, language, music, humor, all these

things that people do, and I look forward every year to finding hundreds of new truths about how different kinds of ideas work in different parts of the brain and change how we think.

I think that it's because of the development of ideas that complicated machines and computers, that started in the middle 1950's, that we are now able to imagine theories of how the brain works for the first time. And so this is going to change all philosophy and all psychology in the future. Because there really are very many new ideas in computer science. Ideas that nobody has ever thought before, wonderful ideas about the nature of knowledge, the nature of language. The structure of reasoning, how new ideas are made from old ideas, and just completely new collection of concepts about how minds work, have come in the last forty or fifty years. And it's only the beginning. I can't imagine this flood of new ideas growing like a population explosion, stopping or slowing down for the next fifty years. Beyond fifty years noone can predict, computer science is increasing in depth and power every year, enough that the student who studies for four years the ideas in computer science and then graduates, now has to go back to school. Because the four year old ideas are obsolete already. Maybe...., there are two sciences today that are changing very rapidly, one is genetics and biology and the other is computer science. And truly in these fields to be an expert, you have to go back to school every three or four years. It's very painful and very glorious. Because there are so many new ideas that make the old ideas seem childish and unimportant.

