AUTOMATIZATION OF INDUSTRY

24 February 1954

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Washington, D. C.

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# AUTOMATIZATION OF INDUSTRY

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COLONEL KLEFF: Throughout our entire Production Unit we have heard many references to automatic machines to the extent or degree to which automatization of industry can be or will be achieved. So it is appropriate that today, in concluding our series of lectures in the Production Unit, we should turn our attention to the automatization of industry.

In selecting our speaker we have been most fortunate in obtaining an outstanding authority in the field of automatization. In addition, Dr. Wiener is the originator of the term "cybernetics" and is also the author of a textbook of that same title. We are fortunate this morning in that our speaker has just returned from a two-month tour of India. I am sure he will refer to that country in his talk.

I would also like to add, parenthetically, that Dr. Wiener was the outstanding choice of last year's class for a return engagement this year during the Production Unit. It is a pleasure to welcome back to the Industrial College of the Armed Forces and to present to this year's class Dr. Norbert Wiener of the Massachusetts Institute of Technology.

DR. WIENER: Thank you, sir. Gentlemen: I am just back from a trip to India and I shall refer to that later in connection with the problems of automatization in countries which are at an earlier stage of the industrial revolution. The things I say will not be dogmatic. They will be things that I have talked over with my friends there, and I will try to give my friends' reactions as well as my own. For the most part I shall talk about automatization itself, and I am going to talk at the beginning a little historically, as to how I came to the whole idea of the thing.

I should like to go all the way around Robin Hood's barn; that's the way the thing happened. I have been working at Tech for many years and, although I am a pure mathematician by training, you can't work at a place like MIT without getting a certain amount of contact with the applications. As I showed a certain interest in them, the engineers, particularly the electrical engineers, tried to get me interested in some of their problems. Vannevar Bush is one of the designers of the automatic computing machine.

You may know there are two sorts of automatic computing machines: the analogy machine, which goes through a process with quantities analogous to the quantities that you want to work with in practice; and the digital machine, where you work with prime numbers. You work with "yes" or "no" processes. The practice is just the choice of these digits, and the digits can be every one from zero when the processes are yes and no.

So our analogy machine uses voltages and currents and the rotations of shafts and integrating discs as the quantities to be combined. Such a machine is naturally suitable for the solving of ordinary differential equations. Why? Because they work in time, and time is a favored variable. As you go along, you specify the state of the instruments in terms of the time. You are dealing with a number of functions of one variable, time.

In addition to ordinary differential equations in mathematics and physics, you have to deal a great deal in partial differential equations, and in partial differential equations you have to deal with functions of two or three or any number of variables; not simply one variable.

Here's the bottleneck. How are we to use a machine of Bush's type in which everything is set out in one variable to deal with several variables? This thing was coming up in the thirties, and in the thirties everything was good and ripe for the modern use of television. I may say that the main ideas of television go back to the nineties. The thing that goes to the thirties is the transfer of television from the selenium cell, which is too slow to be any good, to the ordinary photoelectric cell. But the idea of scanning was perfectly well known and had been since the days of the old selenium cell, which was too slow to be a good scanner.

Remember the main problem of partial differential equation is that you are working with functions of two or more variables, and one of the ways of representing those on one variable is to scan the plate, scan the field that you are working with--in a sense, map two dimensions in one.

At that time I was convinced that the principle of scanning was a much more important thing than television itself. Since then television has been commercially practicable, and I do not know that I have changed my ideas. Anyhow, the idea was that the quantities to be used should be handled by some sort of scanning process and modified by some sort of scanning process.

That meant that you had to do a large number of operations, arithmetical or otherwise, in extremely rapid succession. So, if scanning were to be used, it appeared to me that the operation of such a computing machine would have to be at maximum possible speed in all things. You know that if you want to go to the pacific coast and you take a jet plane from here to St. Louis and walk the rest of the way, your speed is much more like a walking speed than an airplane speed. In other words, you cannot in a quick overall job combine quick and slow processes. That is a principle of engineering. In other words, it would not do in a computing machine of this sort to have your arithmetic done fast when you have a lot of slow processes like that of computing the material on the machine, taking it off the machine, recording it, holding it until you need it, and so on--processes which have to be repeated a great many times. They must be done at a speed suitable to the high speed of the arithmetical operations or you have nothing at all.

Therefore, it became clear to me very early in the game that the high-speed computing machine would not only have to be a high-speed numerical machine but a high-speed programming machine. It would have to, in other words, make decisions as to what to do next, take these decisions out of storage with the same automatism in two combined practices. I made a suggestion of how that thing could be done by magnetic tape. Why should I suggest magnetic tape rather than punch tape? If you used punch tape the multitudinousness of it would clog a room of this size. You have to rush about and restore the machine to the plate to work again or it clogs. The great difficulty with high speed is getting the machine clogged.

I reported on how that machine could be used for certain types of partial differential equation problems. This was before the war, but it was clear that we were going to get in it. I reported to Vannevar Bush. My report was the same thing we have done. Bush felt that the machine would not be ready for use in the last war but would be in reserve for later.

That is the start of my idea in high-speed programming. World War II started in 1939 and it was the next summer at the meeting of the Mathematical Society that I got the idea. That would be 1940. Well I simply will say that what I said was that the computing machine would work equations. So many of them did work out the present-day combination of the high-speed computing machine with something like the machine said to be using Monte Carlo methods, which is being used by Rand and other outfits now.

But then various other ideas occurred to me. It occurred to me that both the numerical and the logical part would be the question of making decisions depending on other decisions; decisions that were either yes or no. That is exactly what the nervous system does in its synopses. It occurred to me that the machine we wanted had a great deal of relevance to what the human brain does. That was one thing. The other thing is that the brain is not preliminarily a computing machine. What are some of the other things done by the brain? They are things we want it to do--planning what we are going to do in building a house, holding a job; directing us to perform a set of moves that we have decided on, and so on.

Then it occurred to me that if you take the crudest work of this sort, which is carrying out the section of a consecutive movement, you do need something like the Taylor system in doing a factory job, ordering one movement after the other, so as to produce an effective purpose.

Then the question came: Why couldn't we program an industrial process by machine as you can program a computing machine? Now, the moment that occurred to me, the answer was: There are very few factory jobs which have as difficult a job of programming as the average elaborate computing job; I am speaking of programming only. Of course there's more to

programming. You have to have something like hands as well as a brain for an automatic factory. But in the case of a chemical factory, where the hands are used simply to turn on jobs, you need eyes. When the eyes are simply used to read gages, those needs are already solved.

They are more difficult, we will say, in the assembly line, but not more difficult than the construction of the hands and eyes which have already been used for handling hot materials in an atomic factory.

Therefore, it became clear to me in the early forties--by 1944, we will say, that the automatic factory was very near. It was near because a lot of work was being put in the high-speed computing machine, and if we were to get the high-speed computing machine--and we needed it badly and wanted it badly--we could not do it without essentially inventing the automatic factory. I should say that is the thing for you people to study --the logical invention. We wanted to see whether, if we had the high-speed computing machine, we would have the automatic factory served to us on a platter.

I said we would. Then I began to get scared, because it struck me that this had a possibility of tremendous unemployment, tremendous disturbance, and, while it might in the long run be of tremendous good, it was a tremendously disturbing factor in an already disturbed situation. I tried to get the unions interested in it but was not successful. Later on I did get Walter Reuther interested in it. I think the unions are now interested in it. At this later time we got the industries interested in it. At the beginning the industries were no more interested in it than the unions. It seemed fantastic. It doesn't now.

Then, I wondered what could be done to make it most useful socially. I finally got the Society for the Advancement of Management interested. People are seriously considering the social changes it will make and what is to be done about it, although I don't think anybody is going to make a definitive answer.

I want to place this, from another point of view, in the historical perspective. Mind you, I will not be able to give you quantities here, or how soon it is coming in. I will not be able to tell you how much money it will save. I can give you nothing but a general consideration of what the thing is good for and what the dangers are.

Well, after all, this is an industrial revolution superimposed on the industrial revolution which took place beginning about a century and one-half ago. What was the first industrial revolution? What were its effects? The first industrial revolution was the industrial revolution of power and energy.

As to its bad effects, we know them very well. To take the industrial revolution in its home in Lancashire, we had there the destruction of home

industry and the displacement of whole populations to the city. The bleakness and barrenness of the north of England today is mostly due to that. However, we have to be careful, because the effects were not all there. As a matter of fact, in the industrial revolution you may say that's a fairly late thing.

What was the first great power machine made? It was the Newcomen engine. What was it used for? For pumping water out of coal mines. Before this was the lowest point in the history of mankind. The mines have had a bad reputation as the worst form of slave labor. Men were "sent to the mines." What was most of the mine labor used for? It was not used in pick-and-shovel work. In the old days it was used in pumping water, and before that, in carrying out water. Almost every mine will become a well if you let it. You must continually fight against water.

In Mexico the Indian population was reduced to half within a century by forced labor. Negro laborers were brought in. The Negro laborers were too tough to work in the mines. They fled to the hills and seacoasts and started a revolution of their own.

The heaviest part of the work, the worst work, was carrying water in buckets by these rough laborers in the mines. The Newcomen engine was the first steam engine to be used for pumping out the water. Nobody carries water up a mine on his back now. "Send them to the mines" was probably the worst sentence of slavery that a man could get.

There's another--"Send them to the galleys." By the way, our present sailing ship is more a steamboat than a sailing ship. The sailing ship was no palace in the old days. It was one of the worst forms of slavery. But the steamboat imitated the mobility of the galleys and the independence of the winds. Another thing; the steamboat came first in the rivers. In the rivers, in addition to the rowing work, there was the work of hauling the boats over rapids. The Volga Boatman song is a song of that. The same thing exists in the Yangtze Kiang--hauling of the boats on the rapids.

Then the Watt engine came in the steamboat. The steamboat is 20 years older than the locomotive.

So, in addition to the damage it did, the first industrial revolution did this sort of thing. It took people out of work that they never should have been put into as people. It took them out of work that would not have been permitted to anybody if it had not been necessary. It took them out because from a cumulative viewpoint, once they began to get the Newcomen engine and the steamboat, their operation was a much smaller item of expense than it was to feed the men.

The first effect of the industrial revolution is that human labor as a source of power became so inefficient that it was not worth anything;

you couldn't afford to have it in any case. The only place you can afford to have it now for heavy work of that sort is where you have enormous misery. Who would think of building an airfield in a country that was not in the greatest poverty, like China and India, by anything other than a bulldozer? I mean, to have men work with pick and shovel to make an airfield in this country would be so expensive you couldn't have them.

The fact is then that man as a source of energy alone has been completely deflated. The power a man can generate for his work is so expensive that no one can pay him for it. You can pay him for something else, but not the power. By the way, this is important in connection with some things I am going to say later.

When it comes to the bad effects of the industrial revolution, the piling of people together was due to many factors, partly ignorance of how to really organize an industry. We had to start from scratch. But one of them has an importance which I think is often not realized. The first big factories were textile factories. Now in the textile factory the power of any prime mover is relatively large, but the power needed for the individual spindle or the individual loom is relatively small. In other words, it is an average problem of subdividing and transmitting your power.

How was it done? Who was the man whose job it was to subdivide the power? What was he called? The millwright. What did the millwright work with? With belts, pulleys, and shafts--O. K. What has happened to the millwright? He has been replaced by the fractional horsepower motor. That's the important thing. In other words, the need of centralization of labor in a factory, which occurred in the textile industry, is obsolete. The history of that is very interesting and does not reflect too well on human intelligence.

In the early days when the motor had been invented and when a factory wanted to electrify, it closed down. Its prime mover was a water turbine or a steam engine, and all the power from the electrical power was from a tremendous motor to move the whole system of shafts. That might have been the best thing to do to introduce electricity at the very beginning, but it is opposed to the very nature of the use of electric power. Electric power is easily subdivided, easily used, exactly where you need it.

By doing that we have the clean factory, which is the well-lighted factory, possibly the factory that won't seize a man in the belt and throw him against the wall or tear his leg off. We also made the building of our factories and the placing of our machines much easier. We don't need rigidity in the relation of one machine to another. That rigidity is costly. To avoid it we once used, in the millwright's days, flexible couplings and various things of that sort, which were not too satisfactory.

The present factory can be as clean as a dance hall, as well lighted as a public auditorium, and not only that, but it needn't be there at all.

I mean that home industry is again possible. It is possible for a man who wants, let us say, to make furniture, to have a few power outlets in one room of his house. He can have a small saw, or even one of these portable saws, and a small lathe, and with that investment he can turn out furniture at a considerable rate and, if a few neighbors do it, he can join with them in shipping the furniture.

The point is that the tremendous centralization of industry which we are accustomed to is no longer necessary. I will refer to that later. We are accustomed to think of the factory as opposed to home industry as the normal mode of production. We see nowadays that what the man in the factory does is very little in the putting in of power.

What is the function of the factory worker? What does he do? He makes discriminations. He sees where to put a bolt, where to put a tool that is going to cut. He sees whether a label is on a can; puts a can aside that is not properly labeled so that somebody can label it, or, better, he pastes the label on himself. He has to do work which involves discrimination--that is, for the lower levels of factory workers. I am not talking about toolmakers; I am talking about the vast majority of factory processes--discriminations are at a very low level. In other words, instead of using a man at what seems now to be a very uneconomical source of power and energy, we are using him as a very uneconomical source of discrimination.

To show how uneconomical it is, let us take what is happening to the chemical industry now. Chemistry deals with reactive substance. The reactive substance is something that in many cases might start a fire; in many cases might start an explosion. If something drops from a pipe, it is likely to put a man's eye out. A chemical factory is a place where you don't want to be. I know the stories of World War I. One was out at DeWitt Arsenal when an officer sat down in his protective clothing after working with one of the poison gases and another man sat down without his protective clothing and died the next day from one of the poisons. That is what can happen in any chemical factory.

Let us leave out any humanitarianism. That costs money. A chemical factory is a place where you want as few people as possible, in general. I am not speaking about the man who designs the process. What does the average man working around the factory do? He reads gages and on the basis of these gages he turns valves to let one substance into a tank, to dump the tank, to turn on the heat, and so on. He works according to a pattern.

It is not at all difficult to have the gages read themselves and actuate the valves through a discriminatory apparatus which is programmed.

You may say the man is better in an emergency. He may be; but I doubt it. If you take the average lower-grade workman in a chemical factory when an emergency comes, it is usually not one he should have known of in advance, or one which should have been provided in the program. If it were a chemical factory the chances are the thing he does will be the wrong thing. There are so many wrong things to do and so few right things. If you have to depend on a man in an emergency, you should anticipate the emergency and if you can anticipate it, you can program it.

What is the result? The chemical factories, say the oil cracking factories, at present are nearly as empty as power stations. There is a crew of a few men. You have numerous factories which make no dent in the labor market. So few people are carried that you can afford to pay them extra wages. I think that is a description of an oil cracking factory now, and of many other chemical factories.

Just as it was in the mine pumping and the work on the galleys by slaves, the replacement of human energy, human work, human power when mechanized power first came in, so it is in some objectionable types of chemical factories, where there is danger.

Don't think for a moment I am asserting that the machines are better than the average human judgment. We have infinitely more judgment than the machine. Our nervous system is such that nothing can compare with it--if we use it. What I am saying is that a large part of factory labor is used at a very small part of its value in the jobs it is doing very inefficiently. I am saying that, for the judgments they are to make, if we can get equally rough judgments done faster, we would need to refine the judgments and improve the man a great deal.

The machine is vastly superior to the man for small judgments done at high speed. It is not anywhere nearly equal to the man if complicated judgments done at low speed are required, where lots of time is taken up with the complication of the judgments. That is not what we hire factory labor for. If we did, we would not get many factories.

So I say the automatic factory, coming in first to the chemical industry, in assembly lines, and on technical problems that are being solved, may come in many other places, even in agriculture. In all of these the feedback notion is most important. The work must be done by what its effects are, and not by what its effects ought to be, by what is actually done, or the machine won't work.

In agriculture a great part of the work, say in cotton picking, in weeding, and in planting, is discriminatory work--low-grade discrimination; but, if you are weeding a field you must be intelligent enough to know a weed from a cabbage. Your machine to do it must also be able to do that. It is not absurd at all to think of discriminatory machines with sense organs and factors being used in agriculture. Much of the

difficulty there is the difficulty of making your machine sufficiently light and also the difficulty of making your machine sufficiently rugged to be towed around a rough field at the end of a tractor, and so on--but nothing contradictory.

We will now consider the automatic factory. Under what circumstances can it be not merely possibly dangerous but a really first-rate peril if misused? I can tell you one right off. Suppose we were to get into a major war and we were to win it. In order to win it we would need two things--a tremendous use of power and of men. I think the Korean War has convinced us that if you occupy, you occupy with men; no matter what other arms you have the Infantry is going to need men for the time being. We would have to have maximum production under those conditions. Under those conditions--I am speaking for myself without any knowledge but just from common sense--the automatic factory would go to the very first priority of the national effort. It is far enough along now so that we could make a program for hurrying it up a great deal, like the sort of program we made in the last war for radar--that was high priority. Furthermore, by the way, the very same men would be available for it, to a large extent.

Now, supposing we win the war and face the end of the war; the know-how of this machine will be thoroughly developed even in as little as four years--very highly developed. There will be a lot of surplus equipment which normally goes back into industry and probably won't. There would be a good chance for a cockeyed world, if you don't care what happens. Putting that back into industry would mean unemployment, great poverty, and a tremendous problem to handle. In other words, we cannot handle the automatic factory on a big scale and end it suddenly unless we are prepared to face the problem of leisure, of supporting people. Half their value of repetitive types in industry has been decreased by machinery. It is going to need a tremendous amount of thought. When I think of the world if it occurs suddenly, I feel it is likely to be catastrophic. Therefore I say it is necessary to think not only of how to get automatization but of how to keep the results of automatization under control, particularly for you people who are facing it as a military possibility and, in case of war, a big military necessity.

That leads me to the last thing I want to talk about--the result of my trip to India. What does automatization mean for the countries, the old countries, which are new countries industrially? Well, these countries are facing some sort of industrial revolution--there is no question--they are in it. They need much more production. One of the chief problems is poverty, plain and simple; a lack of goods, plain and simple. If we take the standard way of industrializing, starting big factories, using tremendous amounts of people, in the poverty area that is going to mean a tremendous transfer--if it goes through in the classical way--of population from the country to the city. That is already taking place in India.

That means the breakup of any community, any solidarity they have. The village may be primitive, but at least a man knows where he stands

there, even though it may be on the very bottom of the ladder. But the man in the village has to move off to a place where he may not know any of the languages, where people may not take an interest in him. As you know, in a country like India the relation of patron and client is something unusual. If you have a servant, you pay him so little you have to supply him with medical care, legal care--if he gets in trouble, and many other things. The same is true in Mexico; the same is true in China. Those countries are not equipped to do that moving of people from the village to the city for factory use. It is likely to cause a tremendous depression of the people, who are already depressed, and to make the poverty, perhaps, not only more nominal in growth than it was, but actually much more burning and biting.

If then you practically impose on them the automatic factory and displace these people from the factory jobs after you move them from the country to the city, if you destroy the village life, the situation appears to me to be about as catastrophic as it can possibly be.

Who said you have to? It is not at all necessary in modernizing a country to go through all the steps that have been gone through in all the countries that have been modernized. It is like what you find in biology. Actually certain biologists are supposed to believe that in embryology there is a state of recapitulation where the embryo goes through different stages that it normally had gone through before in the history of the race. Actually that is not so. There is some suggestion of that picture, unquestionably, but there are a lot of shortcuts. If there weren't we would never get here. We have to do shortcutting in imitating in nine months what the race covered in millions of years.

Similarly, there is no need that the last country to industrialize go through all the steps followed by its predecessors. For example, for a long time a great advantage for England, and I will say for New England, in the textiles industry, was a rather moist climate which prevented countries with a different climate from competing with them. That is all gone. You have humidifiers in the mills, and the humidifiers mean that the mill can be in the desert if you want, and it will work just as well. It means that not only with humidifiers but with air conditioning of various sorts, and so on, a new mill in Puerto Rico can compete with a mill in Massachusetts, and the fact is that the mills are moving there. Not only that, but when you have a new mill there it is likely to buy the least modern equipment--in other words, to go through the whole process of starting with primitive equipment and working up to modern.

That's the thing we have found in the last two years. Countries that had a tremendous advantage like England and the Northeastern United States --because people would go to work in the mills, and frequently there were generations of people working in them--would have those generations broken. New countries like Japan became industrialized, but became industrialized

with the least equipment, often obsolete or semiobsolete equipment. That applies not only to equipment but to methods in general.

I have talked this over with Indian friends. In a country in the position in which India is, a great many cities in the industrial revolution will be simply cut out. If you don't have an industrialized people, you are not displacing people at any rate by starting an automatic factory, if they are not there already. If your chief problem is the problem of getting enough machinists, mechanics, foremen, and so on, you probably are better off to have a job that requires greater skill but fewer men. You can do it quicker than you can get a mass of people of moderate skill educated. That is probably literally true. I know one of their bottlenecks is lack of trained people--expert foremen, mechanics, and so on.

I asked some of the men in one of the scientific laboratories at Delhi about that and they said that six men could work it and they themselves would have to train them. Their problem of getting the NCO's of science trained was often bigger than that of getting the physicists and scientists themselves trained. In a country of that size it may actually be easier to get a small number of people extremely highly trained than it is to get a large number of people fairly well trained.

The automatic factory requires better trained people but many fewer people. As I say, you are increasing the productivity of the country and not causing unemployment where there formerly was employment. Therefore I think the countries which are rapidly forced to industrialize may actually find that the automatic factory was designed for them. In addition to that, the village may continue its village industries through such things as the small fractional horsepower motor. A man who is a good workman in jewelry or furniture work may become a worker for a bigger market, if there is a bigger market.

In other words, the main problem there is goods and production--the problem of wages is small--the problem is the way of making goods, the production of goods, and making them available to more people. They may solve it in a way different from the way we solved our problem. As a matter of fact, I don't see how they can solve it in the same way we did, under the conditions. The countries with fairly primitive conditions, which are in a fairly primitive stage of industrialization, may go immediately into automatization and into household industry on the basis of subdivided power, but they will have economics different from the economics that we have had, at least in the stage we had before coming to automatization.

It may work out ultimately just the same. There is absolutely no need for them to follow us step by step in what we have done--as a matter of fact, that is obvious. There are many countries in the world such as those in Latin America where the airplane has come before the train and

where a great many of the steps we have made have been made in reverse direction. The rail system may never be greatly developed. Road transportation has come before railroad transportation.

There is no need why the other countries in their development should follow our exact pattern, and my prediction is that they won't, and that in this sense we may find that in those which will change, any change in the basis of industry may enable them to catch up easily, because in something really new they are starting at the same time we are.

I have no assurances of that. My observations have been superficial. I don't think I have seen the inside of a factory in India, and I have not talked to industrialists; but I may say that the people I have talked with there about automatization do not regard it as absurd.

I believe I have talked the traditional 50 minutes.

I thank you.

COLONEL KLEFF: The Professor is ready to answer your questions about India or anything else you have in mind.

QUESTION: Doctor, my question has to do with the age of mechanization which the American people have entered into over the past 25 years, and which has probably placed us in a psychological frame of mind that conflicts with the cybernetics or the automatization of industry, inasmuch as we now have to work on making more use of our leisure time. I wonder if you would care to comment on that.

DR. WIENER: I want to say a lot of things about that. For a country that has the largest industries we are one that has the least idea of what it is all about. We have tended to become not only gadget employers but gadget workers. We have tended to compare what the gadget can do with what the human being can do. We have been inclined not only to be willing to respect the machines as our masters but to prostrate ourselves before them.

That does not make sense. A machine is an extremely limited tool. For the things it does it is the right tool but, because it is more efficient as a factory worker on low-scale judgments than a human being, that does not mean that we should respect it as our master throughout, and make our situation one which is an advantage to the machine rather than to us.

We should refrain from the feeling--and this applies to the automatic factory too--that because we have a machine we must employ it at once without reflecting what the employment will do. In other words we have worshipped the machine. We have all these science fiction magazines and

we have the other magazines that tell us how to make things, and so on, but, if you will pardon me, we have a very poor education as to how the invention is made, as to what it is made for and, what the stages are going to be when a new machine comes, and whether it is likely to be invented in several places at once.

I think what we need to do is to get rid of our self-satisfaction in feeling that we know the machine too well and begin to realize that we need to know it a lot better. It is going to be a psychological wrench, but it is a wrench that we must suffer from.

QUESTION: Doctor, I would like to continue that point about leisure a little bit. It appears to me that leisure is a rather unsatisfactory substitute for productive work, from the standpoint of the needs of the human being.

DR. WIENER: Yes and no. I want to say that on leisure, which is simply negative leisure, I agree with your feeling about productive work; but there is leisure touching more than one human need. For example, I am going to take the sort of case that touches me and then I will extend it. I agree I am on a highly specialized job. Leisure to do more thinking, leisure to think things out further, is not exactly productive work, but it is productive whether I sell it or not.

There is another leisure of the country carpenter or the craftsman who really likes his work and can't help doing it, or the small-scale farmer who is in love with his farm and would not be away from there unless he had to. There are lots of examples. This leisure is a nonproductive leisure. I think there clearly is a combination between productivity that can be sold in an open competitive market and productivity so far as human values are concerned. I don't think they are the same.

I want to give an example of that that may not seem to be an example at all, but I think philosophically it is. I met several beautiful, fine old men in India--they were Hindus. According to the code of the Vedas a man should spend 20 years as a youth; 20 years as a soldier, which means he must be an active, fighting participant in the world; 20 years as the head of a family; and the 20 years left will go to the life of a sunnyasi, spent in learning. Some people are doing that at the present day. I met several men who are of the age to become Kanashans. One is the Vice Councillor of the University of Poona. He had been Justice of the High Court, which is the equivalent of being the Chief Justice of one of the States. I met other people like him as well. These people nowadays have the same Asiatic devoted way of the Sanlesar, but are devoting themselves to public functions.

I asked this gentleman, the Vice Councillor of the University of Poona, if his situation was not the attitude of the Veda, if he was not exactly taking a combination of leisure and production, and he said it

certainly was. There are many motives besides gain, and these people are not entirely under the motive of gain, but they are not deprived of the motive of creative activity. Leisure from the standpoint of seeking one's salvation has been realized for them in leisure from the standpoint of performing necessary functions.

I simply give them as an example that the word "leisure" covers many things, and that it is possible to be devoted to something for reasons other than the competitive pay given it and, if we can put a value on that devotion--I mean a human value--it does not follow that what has been taken from industry is taken from service.

QUESTION: I would like to refer to your remarks about India, where the automatic factory might come in without going through all the processes that the United States has gone through. Also referring to your lecture last year, which I looked at, you said this science had some interest in Russia. What I am inviting is your comment on what might occur, contrasting a place like the United States with Russia so far as this automatization might go.

DR. WIENER: When I was in India I was in contact with many people who had traveled in Russia or China. Some of these had tried to find out what Russia was doing with the high-speed computing machine. They got very unsatisfactory answers--some yes, some no.

My interpretation, which is of no special value, is that they are interested in it and are saying "nothing to nobody." The other thing is that I have seen in a Russian periodical or book a discussion on the sort of techniques that are covered in my exterpolation, interpolation, and so on, or closely related to them, in which the automatic factory was mentioned. How much they are committed to it, or not, I don't know. I have no idea about it. The same goes for China. But it is not to be excluded.

QUESTION: It takes a tremendous expenditure of power to build an automatic factory. If you then develop a new and improved 1955 model car you have to practically redo it. To what extent do you feel that the automatic factory would tend to freeze progress on the model that the factory was able to provide?

DR. WIENER: It would not, for this reason--the automatic factory is a machine in which the central part that gives commands does it from tapes. These tapes may require a great deal of labor of design today, but they are not intrinsically expensive pieces of equipment. The same machine can be retooled. That's the nature of the automatic factory; to do other jobs with the same controlling center. Naturally, it costs money to retool--it does at present. I have no evidence that retooling will be a more expensive thing under the automatic factory than it is now.

COLONEL KLEFF: Professor, I am awfully sorry we have to break this off. We have another class. I thank you for coming all the way down from Boston and giving us this excellent demonstration this morning.

DR. WIENER: Thank you very much.

(31 Mar 1954--250)S/ibc



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