04. [Introduction]
Men, Machines, and
the World About

Norbert Wiener began working toward *cybernetics* while engaged in a World War II research project. This project, like the atomic bomb, was funded and organized by Vannevar Bush's (◊02) academic/industrial/military "iron triangle." In response to the dropping of the bomb and other horrors of the war, Wiener decided that a new type of scientist was required, a scientist engaged with the consequences of scientific work (as Wiener argued eloquently in the open letter "A Scientist Rebels"). In the following essay he explained some of the history and concepts of his new cybernetic science, while simultaneously attempting to be the new scientist for which he had called.

Cybernetics is perhaps most immediately recognized for bringing the "cyber" prefix into English usage in terms like "cyborg" and "cyberspace." Other, less immediately obvious terms were also introduced into common speech by Wiener's writings on cybernetics—including "feedback," "input," and "output." These words had existed in English, but for very narrow technical purposes—for the description of engineering problems, the description of machines. Now they are used to describe human interchanges, as when one asks for "feedback" from a colleague on an idea.

Cyberneticists sought to create an overarching study of "communication and control in the animal and machine." The work of the cyberneticists was extremely influential, redefining the object of study for many scientists and technologists. Before cybernetics, technology was largely defined in terms of mechanics. Studies involved movements of power and accompanying observable, physical changes such as one might have found inside Vannevar Bush's memex: its operations of request, recording, calculation, and display moving like an intricate jukebox or clockwork. When "communication and control" became the object of study, the ground shifted. Communication and control involve power differentials and have physical manifestations, to be sure, but are more akin to the workings of a digital computer: most observable, not with a voltage meter or the gaze of the naked eye, but from the inside, from within the system. And these systems tend to overflow the boundaries of any single object. As a result some previous studies of isolated objects seemed outmoded in a cybernetic context, while cybernetics created a framework for studying communication and control systems that spread across multiple entities. The first of these studied, and perhaps the defining case of cybernetics, was the subject of the WWII research project on which Wiener worked: the system of a bomber, an anti-aircraft gun, and the human operators of each.

As Katherine Hayles points out, this type of study has the effect of eroding liberal humanist ideas of subjectivity. That is to say, if we humans are simply parts of systems—our skins not boundaries but permeable membranes, our actions measured as behavior rather than by introspection—the autonomous, sufficient "self" begins to seem an illusion. This anticipates some poststructuralist positions, and echoes, in some ways, Zen Buddhism. However, anticipating many U.S. reactions to poststructuralism and Zen, Wiener did not embrace this thought.

Wiener's devotion to social justice—to becoming a scientist engaged with the social outcomes of his work—is particularly notable in the McCarthyite context of the 1950s. After World War II Wiener refused to take any military funding for his work, and his figure of the new scientist has become an important model for many. Since 1987, Computer Professionals for Social Responsibility (notable opponents of "Star Wars" space weapons and proponents of ethics in high technology contexts) has given a yearly Wiener Award to recognize outstanding contributions toward "social responsibility in computing technology."

As Heinz von Foerster writes in volume four of Wiener's Collected Works (*800*)**:**

A quick comparison of curricula offered in departments of electrical engineering in the early fifties with today's will convince even the skeptic of the significance of [these] ideas: although then almost all that was taught was "power," today almost all that is taught is "communication."

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In *How We Became Posthuman,* Hayles states, "Writing in the years immediately preceding and following World War II, Wiener anticipated some aspects of poststructuralist theories. He questioned

10▸ whether humans, animals, and machines have any 'essential' qualities that exist in themselves, apart from the

15▸ web of relations that constituted them in

16▸ discursive and communicative fields" (91). See the selections from Gilles Deleuze and Felix Guattari (◊27) and Donna Harraway (◊35) for poststructuralist treatments of selfhood. While Zen finds selflessness to be a root of compassion, which in cases such as Vietnamese Nobel Laureate Thich Naht Hanh's leads to direct action, selflessness has often seemed nihilistic to U.S. thinkers—removing the basis for traditional constructions of social justice and life's meaning. It is a question, perhaps, of a small conception of self as opposed to a large one—not that our hand is not part of us, but that much more is.

"Communication and control" is in some ways synonymous with "interactivity." While cybernetics (and even its prefix-progeny such as "cyberspace") may seem anachronistic at the present moment, new media's focus on interactivity is unflagging. From this perspective, the foundational and ongoing importance of cybernetics cannot be overstated. This is true not only in the engineering areas of new media, but also in the arts. Some consider Roy Ascott's "The Construction of Change" (◊10) to be the founding document of new media art—and in that essay Ascott takes cybernetics as his explicit subject. An important early exhibition of new media art was Jasia Reichardt's *Cybernetic Serendipity.* And Jack Burnham and Les Levine's concept of "Software" art (◊16) was, in many ways, constructed as a reaction to the influence of cybernetic concepts on new media art. In the same period, particularly via the influence of John Cage, the arts were also bringing concepts of Zen Buddhism to public consciousness. Nam June Paik (◊15), often considered the first video artist and the first to use television as an art object, considered his work cybernetic and was a close associate of Cage's.

—NWF

From "A Scientist Rebels," an open letter by Wiener to a research scientist, published in The Atlantic Monthly *in January 1947:*

[When] you turn to me for information concerning controlled missiles, there are several considerations which determine my reply. In the past, the comity of scholars has made it a custom to furnish scientific information to any person seriously seeking it. However, we must face these facts: The policy of the government itself during and after the war, say in the bombing of Hiroshima and Nagasaki, has made it clear that to provide scientific information is not a necessarily innocent act, and may entail the gravest consequences. One therefore cannot escape reconsidering the established custom of the scientist to give information to every person who may inquire of him. The interchange of ideas which is one of the great traditions of science must of course receive certain limitations when the scientist becomes an arbiter of life and death.

Further Reading

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Men, Machines, and the World About

Norbert Wiener

I want to point historically to the various things that got me interested in the problems of man, machines, and the world about, because they are relevant to the various things I shall have to say about the present status of the problem.

There were two converging streams of ideas that brought me into cybernetics. One of them was the fact that in the last war, or when it was manifestly coming, at any rate before Pearl Harbor, when we were not yet in the conflict, I tried to see if I could find some niche in the war effort.

In that particular problem, I looked for something to do, and found it in connection with automatic computing machines. Automatic computing machines, of what is called an analogy sort, in which physical quantities are measured and not numbers counted, had already been made very successfully by Professor Vannevar Bush, but there were certain gaps in the theory.

One of the gaps I can express mathematically by saying that these machines could do ordinary differential equations but not partial differential equations. I shall express it physically by the fact that these machines could work in one dimension, namely, time, but not in any efficient way in two dimensions, or three.

Now, it occurred to me that (a) the use of television had shown us a way to represent two or more dimensions on one device; and (b) that the previous device which measured quantities should be replaced by a more precise sort of device that counted numbers.

These were not only my ideas, but at any rate, they were ideas that I had then, and I communicated them in a memorandum to Vannevar Bush, who was in charge of scientific war planning for the entire country. The report that I gave was, in many ways, not in all, a substantial account of the present situation with automatic computing machines. Thus, I had already become familiar with the idea of the machine which does its arithmetic by making choices on the basis of previous choices, and these on the basis of previous choices, and so on, according to a schedule furnished to the machine by punched tape, or by magnetized tape, or other methods of the sort.

The other thing which led me to this work was the problem that I actually got put into a war work. It turned out that at that time Professor Bush did not feel that this contribution was immediate enough to have been effective in the last war. So I looked around for another thing, and the great question that was being discussed at that time was antiaircraft defense. It was at the time of the Battle of England and the existence of the United States as a combatant country—the survival of anybody to combat Germany—seemed to depend on antiaircraft defense.

The antiaircraft gun is a very interesting type of instrument. In the First World War, the antiaircraft gun had been developed as a firing instrument, but one still used range tables directly by hand for firing the gun. That meant, essentially, that one had to do all the computation while the plane was flying overhead, and, naturally, by the time you got in position to do something about it, the plane had already done something about it, and was not there.

It became evident—and this was long before the work that I did—by the end of the First World War, and certainly by the period between the two, that the essence of the problem was to do all the computation in advance and embody it in instruments which could pick up the observations of the plane and fuse them in the proper way to get the necessary result to aim the gun and to aim it, not at the plane, but sufficiently ahead of the plane, so that the shell and the plane would arrive at the same time as induction. That led to some very interesting mathematical theories.

I had some ideas that turned out to be useful there, and I was put to work with a friend of mine, Julian Bigelow. Very soon we ran into the following problem: the antiaircraft gun is not an isolated instrument. While it can be fired by radar, the equivalent and obvious method of firing it is to have a gun pointer. The gun pointer is a human element; this human element is joined with the mechanical elements. The actual fire control is a system involving human beings and machines at the same time. It must be reduced, from an

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engineering point of view, to a single structure, which means either a human interpretation of the machine, or a mechanical interpretation of the operator, or both. We were forced—both for the man firing the gun and for the aviator himself—to replace them in our studies by appropriate machines. The question arose: How would we make a machine to simulate a gun pointer, and what troubles would one expect with the situation?

There is a certain sort of control apparatus used for controlling speed in the governors of steam engines that is used for controlling direction in the ship-steering apparatus, which is called a negative feedback apparatus. In the ship-steering apparatus, the quartermaster who turns the wheel does not move the rudder directly. The rudder is much too heavy in the modern ship for a dozen quartermasters to do that. What he does is to move an element in the steering-engine house which is connected with the tiller of the ship by another element. The difference between the two positions is then conveyed to the steering engines of the two sides of the ship to regulate the admission of steam in the port or starboard steering engine. The steering engine moves the rudder head, the tiller, in such a way as to cancel this interval that has been placed between this moving element and the rudder head, and in doing that it recloses the valves and moves the rudder with the ship. In other words, the rudder is moved by something representing the difference between the commanded position and in its own actual position. That is called negative feedback.

This negative feedback, however, has its diseases. There is a definite pathology to it which was already discussed—you will be rather astonished at the date—in 1868, by the great physicist, Clerk Maxwell, in a paper in the Proceedings of the Royal Society in London. If the feedback of the rudder, or the governor, is too intense, the apparatus will shoot past the neutral position a little further than it was originally past it on one side—will shoot further past it on the other—and will go into oscillation.

Since we thought that the simplest way that we could explain human control was by a feedback, we wondered whether this disease would occur. We went with the following question to our friend, Dr. Arturo Rosenblueth, a physiologist, who was then Cannon's right-hand man in the Harvard Medical School: Is there any nervous disease known in which a person trying to accomplish a task starts swinging

wider and wider, and is unable to finish it? For example, I reach for my cigar. I suppose the ordinary way I control my action is so as to reduce the amount by which the cigar has not yet been picked up. Is that disease of excessive oscillation known?

The answer was most definitely that this disease is known. It has exactly the symptoms named. It occurs in the pathology of the cerebellum, the little brain. It is known as purpose tremor or cerebellar tremor.

Well, that gave us the lead. It looked as if a common pattern could be given to account for human behavior and controlled machine behavior in this case, and that it depended on negative feedback.

That was one of the leads we had. The other lead went back to the study of the automatic controlling machine, the automatic computing machine.

In the first place, automatic computing machinery is of no value except for one thing: its speed. It is more expensive than the ordinary desk machine, enormously more. You do not get anything out of it unless you use it at high speed. But to use a machine at high speed, it is necessary to see that every operation it carries out is carried out at a corresponding speed. If you mix in slow stages with fast stages of the machine, the slow stages always win out. They more nearly govern the behavior of the machine than the fast stages. Therefore, the commands given to a high-speed computing machine cannot be given by hand, while the machine is running. They must be built in in advance to what is called a taping, like punched cards, like punched tape, like magnetic tape, or something of the sort; and your machine must not only control the numbers and their combinations, but the scheduling of operations. Your machine must be a logical machine.

There again we found a great similarity to what a human being was doing. The human nervous system, it is perfectly true, does not exhaust all of human control activity. There is, without any doubt, a control activity in man that goes through hormones, that goes through the blood, and so on. But, as far as the nervous system works, the individual fibers come very near to showing an "all or none" action, that is, they fire or they do not fire; they do not fire halfway. If your individual fibers leading to a given fiber, and connected to it by what is known as a synapse, fire in the proper combination—perhaps at least as many as a

certain number—and if certain so-called inhibitory fibers do not interrupt them, the outgoing fibers fire. Otherwise they do not.

This is an operation of connected switching extremely like the connected switching of the automatic computing machine. This led us to another comparison between the nervous system and the computing machine, and led us, furthermore, to the idea that since the nervous system is not only a computing machine but a control machine, that we may make very general control machines, working on the successive switching basis and much more like the control machine part, the scheduling part of a computing machine, than we might otherwise have thought possible.

In particular, it seemed to us a very hopeful thing to make an automatic feedback control apparatus in which the feedback itself was carried out, in large measure, by successive switching operations such as one finds either in the nervous system or in the computing machine.

It was the fusion of these two ideas, each of which has a human or animal side and has a machine side, which led to *Cybernetics.* That book I wrote in response to a request from a French publisher, and I chose the name, for I felt that this particular combination of ideas could not be left too long unbaptized, took it from the Greek word $\kappa\upsilon\beta\epsilon\rho\nu\alpha\nu$ meaning to govern, as essentially the art of the steersman.

From here on, I can go ahead in very many ways. The first thing that I want to say is that the feedback mechanisms are not only well known to occur in the voluntary actions of the human body, but that they are necessary for its very life.

A few years ago, Professor Henderson of Harvard wrote a book entitled *The Fitness of the Environment.* Anybody who has read that book must regard it as very much of a miracle that any organism can live, and particularly a human organism. Man cannot exist over any variety of temperatures. For that matter, there is no active life, certainly not above the boiling point and below the freezing point, and most planets probably do not have temperatures lying in that convenient range. When I say "boiling point" and "freezing point," I mean of water, because water is a very distinct and special sort of chemical substance.

Now, even a fish cannot exist at the boiling point. It can exist at something like our own temperature to something around the freezing point, perhaps a little bit below, but not much below.

We cannot do anything like that. We either have a chill or a fever if we get near it. The temperature at which life is possible does not vary for man for any extended period of time. It certainly does not vary much over ten degrees, and practically varies much less than that. Again, we must live under constant conditions of saltiness of our blood, of urea concentration in our blood, and so on.

How do we do this? The idea goes back to Claude Bernard and was developed very much by Cannon. We are full of what is called homeostatic mechanisms, which are mechanisms like thermostats. A homeostat is a mechanism which keeps certain bodily conditions within a narrow range. One of those homeostats, located partly, at least, in the medulla, regulates temperature. Another one regulates breathing. Another one of them regulates urea concentration. That is the apparatus of the kidneys. There are not only a few, but many, many such controls.

Now, such control is like the house thermostat. The house thermostat, if you remember it, is a piece of apparatus which has a little thermometer in it made of two pieces of metal. It makes a contact at one temperature and breaks it at others, and it regulates the admission of oil to the furnace and the ignition of that oil. The interesting thing is it has its own pathology. Many of you people must know that.

We have a house in which there is a thermostat which some brilliant architect placed in the only room in the house with a fireplace. The result is that if we want to cool the house in winter, we light the fire because we give false information to the thermostat that the house is warm and the thermostat turns out the furnace fire.

I might point out that a similar behavior in the human thermostat might cause chills or might cause fever. I am going to depart a little from the main part of the formal talk, because this thing is medically very interesting.

There are certain diseases—I am not going into a characterization of these, because I am not going to commit myself before so many doctors—in which the production of certain substances, say cells, the density of certain cells in the blood, as in leukemia, in increasing steadily. However, this steady increase is rather a regular thing in the disease. The actual rate of production and destruction of the cells is much, much higher than the rate of increase. That might be due, conceivably, to an independent disease of production or of destruction, but I do not think so, because if these two

phenomena give you big quantities that are nearly the same, a relatively small change in one will throw this difference out badly and produce a great irregularity in their difference. That is what would have happened if we had no homeostat. I do not think that is what happens. I think that the regularity of the procedure is an indication that we have a homeostat which is working, but working at the wrong level, as if the spring of the house thermostat were changing. That is an idea which is entirely tentative, but which may have serious consequences for medicine.

There is another side to this which is also interesting. The homeostats in the body that I have spoken of are built into the human body. Can we make a homeostat that is partly in the body and partly outside? The answer is definitely yes.

Dr. Bickford at the Mayo Clinic—and he has been followed in this by Dr. Verzeano in the Cushing Veterans Hospital in Framingham—has made an apparatus which takes the brain waves of the electroencephalogram and divides them up, using the total amount that has passed for a stated time, to inject anesthetic either into the vein or into a mask. The procedure is this: as the patient goes under, the brain waves become less active; the injections become less, as less injection is actually needed to keep the level of unconsciousness. In this way, anesthesia can be kept at a reasonably constant level for hours. Here you have a homeostat which is a manufactured one. I do not believe that this is the last example in medicine. I think that the administration of drugs by homeostats which are monitored by their physiologic consequences is a field which has a great future. However, I say this tentatively.

Now, so far I have been talking about man. Let us go to the machine. Where will we find a case where a homeostatic machine is particularly desirable?

Chemistry is an interesting case in point. A chemical factory is generally full of pipes carrying acids, or alkalis, or explosives—at any rate, substances dangerous to work with. When certain thermometers reach certain readings, and certain pressures have been reached, and so on, somebody turns certain valves. He had better turn the right valves, particularly in something like an oil-cracking plant or atomic energy plant, where we are dealing with radioactive materials.

If he has to turn valves on the basis of readings, then, as in the antiaircraft gun, we can build in in advance the combinations which should turn valves as distinguished

from those which should not. The valves may be turned through amplifiers, through what is essentially computing apparatus, by the reading of the instruments themselves, the instruments or sense organs.

You may say, "Very good, but you have to have a man to provide for emergencies."

By the way, it is extremely desirable not to have people in a factory that is likely to explode. People are expensive to replace, and besides we have certain elementary humanitarian instincts.

The question is: Is a man likely to use better emergency judgment than a machine? The answer is no. The reason for that is this: Any emergency you can think of, you can provide for in your computing and control apparatus. If before the time of the emergency, you cannot think of what to do, during the emergency you are almost certain to make a wrong decision. If you cannot figure out a reasonable course of conduct in advance, you simply do not find that the Lord will give you the right thing to do when the emergency comes. Emergencies are provided for in times of peace. I also mean by that, emergencies like the falling of an atomic bomb, about which I may or may not have something to say later.

Then, for perfectly legitimate or even humanitarian reasons, the automatic control system is coming in in the chemical industry and in other especially dangerous industries. However, the same techniques that make possible the automatic assembly line for automobiles, perhaps one automatic assembly line in the textiles industry, and possibly even in dozens of other industries.

The interesting thing is this: that while the successive orders that you give can be almost indefinitely varied in a machine, the instruments which elaborate successive orders are practically standard, no matter what you are doing. These are two variables: one is the quasihuman hands to which the central machine leads, and the other is the sequence of orders put in.

To change from one set of orders, say, from one make of car to another, or to change from one style of body to another, in an assembly line, it is not necessary to alter the order-giving machine. It is enough to alter the particular taping of that machine.

I suppose a good many of you have seen the movie, "Cheaper by the Dozen." In that movie, what I consider to be

the leading idea of the Gilbraiths is completely missed, as it would be in most movies. The Gilbraiths had the idea that man was not working at anything like his full efficiency in his ordinary operations. They thought that families of a dozen were not had by people simply because of human stupidity in the performance of daily tasks, and that this could be avoided by a better ordering of those tasks. That was the motive behind the large family. That was the motive behind the systematic bringing up of those children.

However, when you have simplified a task by reducing it to a routine of consecutive procedures, you have done the same sort of thing that you need to do to put the task on a tape and run the procedure by a completely automatic machine. The problem of industrial management and the systematic handling of ordinary detail by the Gilbraiths, and so forth, is almost the same problem as the taping of a control machine; so that instead of actually improving the conditions of the worker, their advance has tended to telescope the worker out of the picture. That is a very important thing, because it is a procedure taking place now.

I want to say that we are facing a new industrial revolution. The first industrial revolution represented the replacement of the energy of man and of animals by the energy of the machine. The steam engine was its symbol. That has gone so far that there is nothing that steam and the bulldozer cannot do. There is no rate at which pure pick-and-shovel work can be paid in this country which will guarantee a man's doing it willingly. It is simply economically impossible to compete with a bulldozer for bulldozer work.

The new industrial revolution which is taking place now consists primarily in replacing human judgment and discrimination at low levels by the discrimination of the machine. The machine appears now, not as a source of power, but as a source of control and a source of communication. We communicate with the machine and the machine communicates with us. Machines communicate with one another. Energy and power are not the proper concepts to describe this new phenomenon.

If we, in a small way, make human tasks easier by replacing them with a machine execution of the task, and in a large way eliminate the human element in these tasks, we may find we have essentially burned incense before the machine god. There is a very real danger in this country in bowing down before the brass calf, the idol, which is the gadget. I know a great engineer who never thinks further than the construction of the gadget and never thinks of the question of the integration between the gadget and human beings in society. If we allow things to have a reasonably slow development, then the introduction of the gadget as it naturally comes may hurt us enough to provoke a salutary response. So, we realize we cannot worship the gadget and sacrifice the human being to it, but a situation is easily possible in which we may incur a disaster.

Let us suppose that we get into a full-scale war with Russia. I think that Korea, if nothing else, has shown us that modern war means nothing without the infantry. The trouble of occupying Korea is serious enough. The problem of occupying China and Russia staggers the imagination.

We shall have to prepare to do this, if we go to war, at the same time as we have to keep up an industrial production to feed the Army. I mean feed it with munitions as well as with ordinary food and ordinary equipment, a job second to none in history. We shall have to do a maximum production job with a labor market simply scraped to the bottom, and that means the automatic machine.

A war of that sort would mean that we would be putting a large part of our best engineering talent in developing the machine, within two months, probably. It happens that the people who do this sort of job are there. They are the people who were trained in electronic work in the last war when they worked with radar. We are further on with the automatic machine than we were with radar at Pearl Harbor.

Therefore, the situation is that probably two to three years will see the automatic factory well understood and its use beginning to accelerate production. Five years from now will see in the automatic assembly line something of which we possess the complete know-how, and of which we possess a vast backlog of parts.

Furthermore, social reforms do not get made in war. At the end of such a war, we shall find ourselves with a tremendous backlog of parts and know-how, which is extremely tempting to anybody who wants to make a quickie fortune and get out from under, and leave the rest of the community to pick up the pieces. That may very well happen. If that does happen, heaven help us, because we will have an unemployment compared with which the great depression was a nice little joke.

Well, you see the picture drawing together. I suppose one of the things that you people would like would be consolation. Gentlemen, there is no Santa Claus! If we want to live with the machine, we must understand the machine, we must not worship the machine. We must make a great many changes in the way we live with other people. We must value leisure. We must turn the great leaders of business, of industry, of politics, into a state of mind in which they will consider the leisure of people as their business and not as something to be passed off as none of their business.

We shall have to do this unhampered by slogans which fitted a previous stage in society but which do not fit the present.

We shall have to do this unhampered by the creeping paralysis of secrecy which is engulfing our government, because secrecy simply means that we are unable to face situations as they really exist. The people who have to control situations are as yet in no position to handle them.

We shall have to realize that while we may make the machines our gods and sacrifice men to machines, we do not have to do so. If we do so, we deserve the punishment of idolators. It is going to be a difficult time. It we can live through it and keep our heads, and if we are not annihilated by war itself and our other problems, there is a great chance of turning the machine to human advantage, but the machine itself has no particular favor for humanity.

It is possible to make two kinds of machines (I shall not go into the details): the machine whose taping is determined once and for all, and the machine whose taping is continually being modified by experience. The second machine can, in some sense, learn.

Gentlemen, the moral problem of the machine differs in no way from the old moral problem of magic. The fact that the machine follows the law of Nature and that magic is supposed to be outside of Nature is not an interesting distinction. Sorcery was condemned in the Middle Ages. In those ages certain modern types of gadgeteer would have been hanged or burned as a sorcerer. An interesting thing is that the Middle Ages to a certain extent—oh, I don't mean in its love for the flame, but in its condemnation of the gadgeteer—would have been right; namely, sorcery was not the use of the supernatural, but the use of human power for other purposes than the greater glory of God.

Now, I am not theistic when I say the greater glory of God. I mean by God some end to which we can give a justifiable human value. I say that the medieval attitude is the attitude of the fairy tale in many things, but the attitude of the fairy tale is very wise in many things that are relevant to modern life.

If you have the machine which grants you your wish, then you must pay attention to the old fairy tale of the three wishes, which tells you that if you do make a wish which is likely to be granted, you had better be very sure that it is what you want and not what you think you want.

You know Jacob's story of the monkey's paw, the talisman. An old couple came into possession of this, and learned that it would grant them three wishes. The first wish was for two hundred pounds. Immediately, a man appeared from the factory to say that their boy had been crushed in the machinery, and although the factory recognized no responsibility, they were ready to give a solatium of two hundred pounds.

After this they wished the boy back again, and his ghost appeared.

Then they wished the ghost to go away, and there they were left with nothing but a dead son. That is the story.

This is a piece of folklore; but the problem is quite as relevant to the machine as to any piece of magic.

However, a machine can learn. Here the folklore parallel is to the tale of the fisherman and the genie. You all know the story. The fisherman opens a bottle which he has found on the shore, and the genie appears. The genie threatens him with vengeance for his own imprisonment. The fisherman talks the genie back into the bottle. Gentlemen, when we get into trouble with the machine, we cannot talk the machine back into the bottle.