

21CW2023: Workshop Pre-Reading

I hope that you will take time to review following selections, which will provide some shared context for our discussions at the 2023 IEEE Workshop on Norbert Wiener in the 21st Century (21CW2023). As you will see, Wiener had much to say regarding our theme, "The Future of Work in the Age of Automation."

Selections by Norbert Wiener

As Norbert Wiener developed a mathematical basis for automation, he considered the societal impact of such automation, both on physical labor and on white collar jobs. A message he stated repeatedly from the 1940s to the 1960s was that the adoption of technology must consider the societal dimension. Perhaps Wiener's most clear exposition of the threat that automation could pose is found in his **1949 letter to Walter Reuther, Present of the Union of Automobile Workers** (Detroit, Michigan, USA). Here he provides both a warning of technology impact, and displays his sense of responsibility that a technology producer should warn those whose livelihoods were under threat.

Wiener had an aversion to "gadget worshippers", believers in some necessarily beneficial trajectory of technology. This was summarised most clearly in his final work, a short and astounding piece called [God & Golem, Inc. \(1964\)](#). **Chapter V** from this work is included as a representation of Wiener's most mature thinking. The chapter ends: "The world of the future will be an ever more demanding struggle against the limitations of our intelligence, not a comfortable hammock in which we can lie down to be waited upon by our robot slaves" (69).

Wiener is perhaps most famous for two books, excerpts from each of which are provided. [Cybernetics, or Control and Communication in the Animal and the Machine](#) (1st edition 1948, 2nd edition 1961) provides a broad and somewhat mathematical description of his approach; the topic of automation appears in **the final pages of the book's "Introduction"** (beginning near the *bottom* of p. 26). A more accessible version for non-mathematicians can be found in [The Human Use of Human Beings, 1950](#) (the title is a reference to Kant's statement on human dignity); a short excerpt from this work, which provides another "take" on the theme of automation, is included as well.

A summary of the dilemma faced by the technology producer appears in the second part of his autobiography, [I Am a Mathematician, 1956](#), with a reference to his approaching officials of two unions (308). Regarding the typographers' union, his warning was considered too far ahead. The decimation of typographers' jobs took place four decades after his warning, in the mid-1980s, particularly with the introduction of desktop publishing.

Additional Selections

Wiener's dystopian vision regarding the threat that automation could pose to work was the subject of **Kurt Vonnegut's** first science fiction novel, [Player-Piano, 1953](#). An excerpt of that novel is included here for reference (pp. 9-23).

Also attached is a set of press articles, primarily US and Australian commentators. This is not at all meant to be a representative sample of writing. Rather, it provides a cluster of views from six to nine years ago, and then two from this year. Interesting to me are the 2017 and 2023 articles by Barry Eichengreen from UC Berkeley, in which he switches from a "no problem" to a "problem" perspective.

I am looking forward to the discussion, and welcome other reading suggestions.

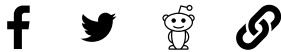
Greg Adamson, g.adamson@ieee.org.



Father of Cybernetics Norbert Wiener's Letter to UAW President Walter Reuther

1949 letter from a leading scientist to the head of the American auto workers union warning him about new technology and the negative impact it would have on manufacturing workers.

Submitted by apophysis on January 24, 2011



South Tamworth, August 13, 1949

Walter Reuther

Union of Automobile Workers

Detroit, Michigan

Dear Mr. Reuther,

First, I should like to explain who I am. I am Professor of Mathematics at the Massachusetts Institute of Technology, and I am the author of the recently published book, *Cybernetics*. As you will see, if you know of this book, I have been interested for a long time in the problem of automatic machinery and its social consequences. These consequences seem to me so great that I have made repeated attempts to get in touch with the Labor Union movement, and to try to acquaint them with what may be expected of automatic machinery in the near future. This situation has

been brought to a head by the fact that I have been approached recently by one of the leading industrial corporations with the view to advising them as to whether to go into the problem of making servo-mechanisms, that is, artificial control mechanisms, as part of their extended program.

Technically I have no doubt what direction my advice should take. My technical advice would be to construct an inexpensive small scale, high speed computing machine, together with adequate apparatus for putting the readings of photo-electric cells, thermometers, and other instruments into the machine as numerical data, and for putting numerical out-put data into the motion of shafts and other out-put apparatus. The position of these output shafts should be monitored by proper sense organs, and be put back into the machine as part of the information on which it is to work.

The detailed development of the machine for particular industrial purpose is a very skilled task, but not a mechanical task. It is done by what is called 'taping' the machine in the proper way, much as present computing machines are taped. This apparatus is extremely flexible, and susceptible to mass production, and will undoubtedly lead to the factory without employees; as for example, the automatic automobile assembly line. In the hands of the present industrial set-up, the unemployment produced by such plants can only be disastrous. I would give a guess that a critical situation is bound to arise under any condition in some ten to twenty years; but that if war should make the replacement of labor mobilized into the services an immediate necessity, we should probably have a concentrated effort put into this work which might well lead to large scale industrial unemployment within two years.

I do not wish personally to be responsible for any such state of affairs. I have, therefore, turned down unconditionally the request of the industrial company which has tried to consult me. However, it is manifestly not enough to take a negative attitude on this. If I do not put this information in the hands of the industrialists, it is merely a question of time when so obvious a method of procedure will be urged upon them by other people.

Therefore, the procedure which I shall follow depends finally upon whether I can get you and the labor interests you represent to pay serious attention to this serious situation. I have tried to do this in the past without success; and I do not blame you people for it, but since then there has been a turn-over in personnel among you and the present group of labor leaders seem to have transcended the point of view of the shop to a sufficient extent to make it worthwhile for me to make an appeal to you again.

What I am proposing is this. First, that you show a sufficient interest in the very pressing menace of the large-scale replacement of labor by machine on the level not of energy, but of judgment, to be willing to formulate a policy towards this problem. In particular, I do not think it would be at all foolish for you to steal a march upon the existing industrial corporations in this matter; and while taking a part in production of such machines to secure the profits in them to an organization dedicated to the benefit of labor. It may be on the other hand, that you think the complete suppression (sic) of these ideas is in order. In either case, I am willing to back you loyally, and without any demand or request for personal returns in what I consider will be a matter of public policy. I wish to warn you, however, that my own passiveness in this matter will not, on the face of it, produce a passiveness in other people who may come by the same ideas, and that these ideas are very much in the air.

If you determine that the matter does not deserve your serious consideration, you will leave me in a very difficult position. I do not wish to contribute in any way to selling labor down the river, and I am quite aware that any labor, which is in competition with slave labor, whether the slaves are human or mechanical, must accept the conditions of work of slave labor. For me merely to remain aloof is to make sure that the development of these ideas will go into other hands which will probably be much less friendly to organized labor.

Under these circumstances, I should probably have to try to find some industrial group with as liberal and honest a labor policy as possible and put my ideas in their hands. I must confess, however, that I know of no group what has at the same time a sufficient honesty of purpose to be entrusted with these developments, and a sufficiently firm economic and social position to be able to hold these results substantially in their own hands.

I have a book ((The Human Use of Human Beings) which will be forthcoming with Houghton-Mifflin next spring which will bring these ideas to a head. If you so wish, I shall send you copies of the relevant chapters.

Naturally, I do not expect you to take these matters on my momentary say-so. If you show sufficient interest to be willing to push the matter further, I shall be glad to put my ideas both technical and social at your disposal, so that you will be able to judge them better.

Sincerely yours,

Norbert Wiener

Department of Mathematics

Massachusetts Institute of Technology

Cambridge 39, Massachusetts

**technology, United States, car industry,
United Auto Workers (UAW), unemployment, letters,
Norbert Weiner, Walter Reuther, CIO**

Comments

KriegPhilosophy 12 years 2 months ago

Thank's for posting this I have always been Interested with man's merge with machinery.

Cheers

Khawaga 12 years 2 months ago

Really interesting. Thanks.

Chilli Sauce 12 years 2 months ago

Do we know if he got a response?



NORBERT WIENER

GOD & GOLEM, Inc.

A Comment on Certain Points where
Cybernetics Impinges on Religion



V

I have said that the reprobation attaching in former ages to the sin of sorcery attaches now in many minds to the speculations of modern cybernetics. For make no mistake, if but two hundred years ago a scholar had pretended to make machines that should learn to play games or that should propagate themselves, he would surely have been made to assume the sanbenito, the gown worn by the victims of the Inquisition, and have been handed over to the secular arm, with the injunction that there be no shedding of blood; surely, that is, unless he could convince some great patron that he could transmute the base metals into gold, as Rabbi Löw of Prague, who claimed that his incantations blew breath of life into the Golem of clay, had persuaded the Em-

peror Rudolf. For even now, if an inventor could prove to a computing-machine company that his magic could be of service to them, he could cast black spells from now till doomsday, without the least personal risk.

What is sorcery, and why is it condemned as a sin? Why is the foolish mummery of the Black Mass so frowned upon?

The Black Mass must be understood from the point of view of the orthodox believer. For others it is a meaningless if obscene ceremony. Those who participate in it are far nearer to orthodoxy than most of us realize. The principal element in the Black Mass is the normal Christian dogma that the priest performs a real miracle, and that the Element of the Host becomes the very Blood and Body of Christ.

The orthodox Christian and the sorcerer agree that after the miracle of the consecration of the Host is performed, the Divine Elements are capable of performing further miracles. They agree moreover that the miracle of transubstantiation can be performed only by a duly ordained priest. Furthermore, they agree that such a priest can never lose the power to perform the miracle, though if he is unfrocked he performs it at the sure peril of damnation.

Under these postulates, what is more natural than that some soul, damned but ingenious, should have hit upon the idea of laying his hold on the magic Host and using its powers for his personal advantage. It is here, and not in any ungodly orgies, that the central sin of the Black Mass consists. The magic of the Host is intrinsically good: its perversion to other ends than the Greater Glory of God is a deadly sin.

This was the sin which the Bible attributes to Simon Magus, for bargaining with Saint Peter for the miraculous powers of the Christians. I can well imagine the puzzled aggrievement of the poor man when he discovered that these powers were not for sale, and that Peter refused to accept what was, in Simon's mind, an honorable, acceptable, and natural bargain. It is an attitude that most of us have encountered when we have declined to sell an invention at the really flattering terms offered us by a modern captain of industry.

Be that as it may, Christianity has always considered simony as a sin, that is, the buying and selling of the offices of the Church and the supernatural powers implied therein. Dante indeed places it among the worst of sins, and consigns to the bottom of his Hell some of the most notorious practitioners of simony of his own times. How-

ever, simony was a besetting sin of the highly ecclesiastical world in which Dante lived, and is of course extinct in the more rationalistic and rational world of the present day.

It is extinct! It is extinct. It is extinct? Perhaps the powers of the age of the machine are not truly supernatural, but at least they seem beyond the ordinary course of nature to the man in the street. Perhaps we no longer interpret our duty as obliging us to devote these great powers to the greater glory of God, but it still seems improper to us to devote them to vain or selfish purposes. There is a sin, which consists of using the magic of modern automatization to further personal profit or let loose the apocalyptic terrors of nuclear warfare. If this sin is to have a name, let that name be Simony or Sorcery.

For whether we believe or not in God and his greater glory, not all things are equally permitted to us. The late Mr. Adolf Hitler to the contrary, we have not yet arrived at that pinnacle of sublime moral indifference which puts us beyond Good and Evil. And just so long as we retain one trace of ethical discrimination, the use of great powers for base purposes will constitute the full moral equivalent of Sorcery and Simony.

As long as automata can be made, whether in

the metal or merely in principle, the study of their making and their theory is a legitimate phase of human curiosity, and human intelligence is stultified when man sets fixed bounds to his curiosity. Yet there are aspects of the motives to automatization that go beyond a legitimate curiosity and are sinful in themselves. These are to be exemplified in the particular type of engineer and organizer of engineering which I shall designate by the name of *gadget worshiper*.

I am most familiar with gadget worshipers in my own world, with its slogans of free enterprise and the profit-motive economy. They can and do exist in that through-the-looking-glass world where the slogans are the dictatorship of the proletariat and Marxism and communism. Power and the search for power are unfortunately realities that can assume many garbs. Of the devoted priests of power, there are many who regard with impatience the limitations of mankind, and in particular the limitation consisting in man's un-dependability and unpredictability. You may know a mastermind of this type by the subordinates whom he chooses. They are meek, self-effacing, and wholly at his disposal; and on account of this, are generally ineffective when they once cease to be limbs at the disposal of his

brain. They are capable of great industry but of little independent initiative—the chamberlains of the harem of ideas to which their Sultan is wedded.

In addition to the motive which the gadget worshiper finds for his admiration of the machine in its freedom from the human limitations of speed and accuracy, there is one motive which it is harder to establish in any concrete case, but which must play a very considerable role nevertheless. It is the desire to avoid the personal responsibility for a dangerous or disastrous decision by placing the responsibility elsewhere: on chance, on human superiors and their policies which one cannot question, or on a mechanical device which one cannot fully understand but which has a presumed objectivity. It is this that leads shipwrecked castaways to draw lots to determine which of them shall first be eaten. It is this to which the late Mr. Eichmann entrusted his able defense. It is this that leads to the issue of some blank cartridges among the ball cartridges furnished to a firing squad. This will unquestionably be the manner in which the official who pushes the button in the next (and last) atomic war, whatever side he represents, will salve his conscience. And it is an old trick in magic—one,

however, rich in tragic consequences—to sacrifice to a vow the first living creature that one sees after safe return from a perilous undertaking.

Once such a master becomes aware that some of the supposedly human functions of his slaves may be transferred to machines, he is delighted. At last he has found the new subordinate—efficient, subservient, dependable in his action, never talking back, swift, and not demanding a single thought of personal consideration.

Such subordinates are contemplated in Čapek's play *R.U.R.* The Slave of the Lamp makes no demands. He does not ask for a day off each week or a television set in his servant's quarters. In fact, he demands no quarters at all but appears out of nowhere when the lamp is rubbed. If your purposes involve you in a course sailing pretty close-hauled to the moral wind, your slave will never reprove you, even to the extent of a questioning glance. Now you are free, to dree your weird where destiny may lead you!

This type of mastermind is the mind of the sorcerer in the full sense of the word. To this sort of sorcerer, not only the doctrines of the Church give a warning but the accumulated common sense of humanity, as accumulated in legends, in myths, and in the writings of the con-

scious literary man. All of these insist that not only is sorcery a sin leading to Hell but it is a personal peril in this life. It is a two-edged sword, and sooner or later it will cut you deep.

In the *Thousand Nights and a Night*, the tale of the "Fisherman and the Jinni" is well to the point. A fisherman, casting his nets off the coast of Palestine, pulls up an earthen jar sealed with the Seal of Solomon. He breaks the seal, smoke boils out of the jar and takes the figure of an enormous Jinni. The Being tells him that he is one of those rebellious beings imprisoned by the great King Solomon; that at first he had intended to reward anyone who liberated him with power and riches; but that in the course of ages, he had come to the decision to slay the first mortal he might meet, and above all the man who should bring him freedom.

Fortunately for himself, the fisherman seems to have been an ingenious fellow, with a rich line of blarney. He plays on the vanity of the Jinni and persuades him to show how such a great Being could have been confined in such a small vessel by going back again into the jar. He claps the sealed lid on again, throws the vessel back into the sea, congratulates himself on his narrow escape, and lives happily ever after.

In other tales, the chief character does not have so accidental an encounter with magic and either comes even closer to the edge of catastrophe or incurs utter ruin. In Goethe's poem, *The Sorcerer's Apprentice*, the young factotum who cleans the master's magic garments, sweeps his floors, and fetches his water is left alone by the sorcerer, with the command to fill his water butt. Having a full portion of that laziness which is the true mother of invention—it led the boy who tended Newcomen's engine to fasten the valve string which he was to pull to the crosshead, and so led to the idea of the automatic valve gear—the lad remembers some fragments of an incantation which he has heard from his master and puts the broom to work fetching water. This task the broom carries out with promptness and efficiency. When the water begins to overflow the top of the water butt, the boy finds that he does not remember the incantation that the magician has used to stop the broom. The boy is well on the way to be drowned when the magician comes back, recites the words of power, and gives the apprentice a good wholesome scolding.

Even here the final catastrophe is averted through a *deus ex machina*. W. W. Jacobs, an English writer of the beginning of the present

century, has carried the principle to its stark logical conclusion in a tale called "The Monkey's Paw,"* which is one of the classics of the literature of horror.

In this tale, an English working family is sitting down to dinner in its kitchen. The son leaves to work at a factory, and the old parents listen to the tales of their guest, a sergeant-major back from service in the Indian army. He tells them of Indian magic and shows them a dried monkey's paw, which, he tells them, is a talisman which has been endowed by an Indian holy man with the virtue of giving three wishes to each of three successive owners. This, he says, was to prove the folly of defying fate.

He says that he does not know what were the first two wishes of the first owner, but that the last one was for death. He himself was the second owner, but his experiences were too terrible to relate. He is about to cast the paw on the coal fire, when his host retrieves it, and despite all the sergeant-major can do, wishes for £200.

Shortly thereafter there is a knock at the door.

* Jacobs, W. W., "The Monkey's Paw," in *The Lady of the Barge*, Dodd, Mead, and Company; also in *Modern Short Stories*, Ashmun, Margaret, Ed., The Macmillan Co., New York, 1915.

A very solemn gentleman is there from the company which has employed his son. As gently as he can, he breaks the news that the son has been killed in an accident at the factory. Without recognizing any responsibility in the matter, the company offers its sympathy and £200 as a solatium.

The parents are distracted, and at the mother's suggestion, they wish the son back again. By now it is dark without, a dark windy night. Again there is a knocking at the door. Somehow the parents know that it is their son, but not in the flesh. The story ends with the third wish, that the ghost should go away.

The theme of all these tales is the danger of magic. This seems to lie in the fact that the operation of magic is singularly literal-minded, and that if it grants you anything at all it grants what you ask for, not what you should have asked for or what you intend. If you ask for £200, and do not express the condition that you do not wish it at the cost of the life of your son, £200 you will get, whether your son lives or dies.

The magic of automation, and in particular the magic of an automatization in which the devices learn, may be expected to be similarly literal-minded. If you are playing a game according to

certain rules and set the playing-machine to play for victory, you will get victory if you get anything at all, and the machine will not pay the slightest attention to any consideration except victory according to the rules. If you are playing a war game with a certain conventional interpretation of victory, victory will be the goal at any cost, even that of the extermination of your own side, unless this condition of survival is explicitly contained in the definition of victory according to which you program the machine.

This is more than a purely innocent verbal paradox. I certainly know nothing to contradict the assumption that Russia and the United States, either or both of them, are toying with the idea of using machines, learning machines at that, to determine the moment of pushing the atomic-bomb button which is the *ultima ratio* of this present world of ours.

For many years all armies have played war games, and these games have always been behind the times. It has been said that in every war, the good generals fight the last war, the bad ones the war before the last. That is, the rules of the war game never catch up with the facts of the real situation.

This has always been true, though in periods

of much war, there has always been a body of seasoned warriors who have experienced war under conditions that have not varied very rapidly. These experienced men are the only "war experts," in the true sense of the word. At present, there are no experts in atomic warfare: no men, that is, who have any experience of a conflict in which both sides have had atomic weapons at their disposal and have used them. The destruction of our cities in an atomic war, the demoralization of our people, the hunger and disease, and the incidental destruction (which well may be far greater than the number of deaths from explosion and immediate fallout) are known only by conjecture.

Here those who conjecture the least amount of secondary damage, the greatest possibility of the survival, of the nations under the new type of catastrophe, can and do draw about themselves the proud garment of patriotism. If war is utterly self-destructive, if a military operation has lost all possible sense, why then the Army and Navy have lost much of their purpose, and the poor loyal generals and admirals will be thrown out of work. The missile companies will no longer have the ideal market where all the goods can be used only once and do not remain to compete

with other goods yet to be made. The clergy will be cheated of the enthusiasm and exultation which go with a crusade. In short, when there is a war game to program such a campaign, there will be many to forget its consequences, to ask for the £200 and to forget to mention that the son should survive.

While it is always possible to ask for something other than we really want, this possibility is most serious when the process by which we are to obtain our wish is indirect, and the degree to which we have obtained our wish is not clear until the very end. Usually we realize our wishes, insofar as we do actually realize them, by a feedback process, in which we compare the degree of attainment of intermediate goals with our anticipation of them. In this process, the feedback goes through us, and we can turn back before it is too late. If the feedback is built into a machine that cannot be inspected until the final goal is attained, the possibilities for catastrophe are greatly increased. I should very much hate to ride on the first trial of an automobile regulated by photoelectric feedback devices, unless there were somewhere a handle by which I could take over control if I found myself driving smack into a tree.

The gadget-minded people often have the illusion that a highly automatized world will make smaller claims on human ingenuity than does the present one and will take over from us our need for difficult thinking, as a Roman slave who was also a Greek philosopher might have done for his master. This is palpably false. A goal-seeking mechanism will not necessarily seek *our* goals unless we design it for that purpose, and in that designing we must foresee all steps of the process for which it is designed, instead of exercising a tentative foresight which goes up to a certain point, and can be continued from that point on as new difficulties arise. The penalties for errors of foresight, great as they are now, will be enormously increased as automatization comes into its full use.

At present, there is a great vogue for the idea of avoiding some of the dangers, and in particular the dangers accompanying atomic war, by so-called "failsafe" devices. The notion behind this is that even if a device does not perform properly, it is possible to direct the mode of its failure in a harmless way. For example, if a pump is to break down, it is often much better that it do so by emptying itself of water than by exploding under pressure. When we are facing a particular

understood danger, the failsafe technique is legitimate and useful. However, it is of very little value against a danger whose nature has not been already recognized. If, for example, the danger is a remote but terminal one to the human race, involving extermination, only a very careful study of society will exhibit it as a danger until it is upon us. Dangerous contingencies of this sort do not bear a label on their face. Thus the failsafe technique, while it may be necessary to avoid a human catastrophe, can most emphatically not be regarded as a sufficient precaution.

As engineering technique becomes more and more able to achieve human purposes, it must become more and more accustomed to formulate human purposes. In the past, a partial and inadequate view of human purpose has been relatively innocuous only because it has been accompanied by technical limitations that made it difficult for us to perform operations involving a careful evaluation of human purpose. This is only one of the many places where human impotence has hitherto shielded us from the full destructive impact of human folly.

In other words, while in the past humanity has faced many dangers, these have been much easier to handle, because in many cases peril offered

itself from one side only. In an age where hunger is the great threat, there is safety in an increased production of food, and not much danger from it. With a higher death rate (and above all, a high infant death rate) and a medicine of very little effectiveness, the individual human life was of the greatest value, and it was appropriate to enjoin upon us to be fruitful and multiply. The pressure of the threat of hunger was like the pressure of gravity, to which our muscles, bones, and tendons are always attuned.

The change in the tensions of modern life, which results both from the rise of new strains and the disappearance of old ones, is rather analogous to the new problems of space travel. In the weightlessness that is imposed upon us in a space vehicle, this one-directional constant force, upon which we count so much in our daily life, is no longer present. The traveler in such a space vehicle must have handles to which to cling, squeeze bottles for his food and drink, various directional auxiliaries from which he can judge his position, and even at that, though it now appears that his physiology will not be too seriously affected, he may scarcely be as comfortable as he would like. Gravity is our friend at least as much as it is our enemy.

Similarly, in the absence of hunger, overproduction of food, purposelessness, and an attitude of waste and squandering become serious problems. Improved medicine is one factor contributing to overpopulation, which is by far the most serious danger confronting mankind at the moment. The old maxims by which humanity has lived so long—such as “a penny saved is a penny gained”—are no longer to be taken as valid without question.

I have been to dinner with a group of doctors—they were talking freely among themselves, and they were sufficiently self-confident not to be afraid of saying unconventional things—when they began to discuss the possibility of a radical attack upon the degenerative disease known as old age. They did not consider it as beyond all possibility of medical attack, but rather looked forward to the day—perhaps not too far in the future—when the time of inevitable death should be rolled back, perhaps into the indefinite future, and death would be accidental, as it seems to be with giant sequoias and perhaps some fish.

I am not saying that they were right in this conjecture (and I am quite sure that they would not claim it to be more than a conjecture), but the weight of the names supporting it—there was a

Nobel laureate present—was too great to allow me to reject the suggestion out of hand. Consoling as the suggestion may seem at first sight, it is in reality very terrifying, and above all for the doctors. For if one thing is clear, it is that humanity as such could not long survive the indefinite prolongation of all lives which come into being. Not only would the nonselfsupporting part of humanity come to outweigh the part on which its continued existence depends, but we should be under such a perpetual debt to the men of the past that we should be totally unprepared to face the new problems of the future.

It is unthinkable that all lives should be prolonged in an indiscriminate way. If, however, there exists the possibility of indefinite prolongation, the termination of a life or even the refusal or neglect to prolong it involves a moral decision of the doctors. What will then become of the traditional prestige of the medical profession as priests of the battle against death and as ministers of mercy? I will grant that there are cases even at present when doctors qualify this mission of theirs and decide not to prolong a useless and miserable life. They will often refuse to tie the umbilical cord of a monster; or when an old man suffering from an inoperable cancer falls victim to the "old

man's friend," hypostatic pneumonia, they will grant him the easier death rather than exact from him the last measure of pain to which survival will condemn him. Most often this is done quietly and decently, and it is only when some incontinent fool blabs the secret that the courts and the papers are full of the talk of "euthanasia."

But what if such decisions, instead of being rare and unmentioned, will have to be made, not in a few special cases, but in the case of almost every death? What if every patient comes to regard every doctor, not only as his savior but his ultimate executioner? Can the doctor survive this power of good and evil that will be thrust upon him? Can mankind itself survive this new order of things?

It is relatively easy to promote good and to fight evil when evil and good are arranged against one another in two clear lines, and when those on the other side are our unquestioned enemies, those on our side our trusted allies. What, however, if we must ask, each time in every situation, where is the friend and where the enemy? What, moreover, when we have put the decision in the hands of an inexorable magic or an inexorable machine of which we must ask the right questions in advance, without fully understanding the

operations of the process by which they will be answered? Can we then be confident in the action of the Monkey's Paw from which we have requested the grant of the £200?

No, the future offers very little hope for those who expect that our new mechanical slaves will offer us a world in which we may rest from thinking. Help us they may, but at the cost of supreme demands upon our honesty and our intelligence. The world of the future will be an ever more demanding struggle against the limitations of our intelligence, not a comfortable hammock in which we can lie down to be waited upon by our robot slaves.

Cybernetics:
or Control and
Communication
in the Animal
and the Machine
Norbert Wiener



CYBERNETICS

*or control and communication
in the animal and the machine*

NORBERT WIENER

second edition



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similar in the case of artificial limbs. The loss of a segment of limb implies not only the loss of the purely passive support of the missing segment or its value as mechanical extension of the stump, and the loss of the contractile power of its muscles, but implies as well the loss of all cutaneous and kinesthetic sensations originating in it. The first two losses are what the artificial-limb-maker now tries to replace. The third has so far been beyond his scope. In the case of a simple peg leg, this is not important: the rod that replaces the missing limb has no degrees of freedom of its own, and the kinesthetic mechanism of the stump is fully adequate to report its own position and velocity. This is not the case with the articulated limb with a mobile knee and ankle, thrown ahead by the patient with the aid of his remaining musculature. He has no adequate report of their position and motion, and this interferes with his sureness of step on an irregular terrain. There does not seem to be any insuperable difficulty in equipping the artificial joints and the sole of the artificial foot with strain or pressure gauges, which are to register electrically or otherwise, say through vibrators, on intact areas of skin. The present artificial limb removes some of the paralysis caused by the amputation but leaves the ataxia. With the use of proper receptors, much of this ataxia should disappear as well, and the patient should be able to learn reflexes, such as those we all use in driving a car, which should enable him to step out with a much surer gait. What we have said about the leg should apply with even more force to the arm, where the figure of the manikin familiar to all readers of books of neurology shows that the sensory loss in an amputation of the thumb alone is considerably greater than the sensory loss even in a hip-joint amputation.

I have made an attempt to report these considerations to the proper authorities, but up to now I have not been able to accomplish much. I do not know whether the same ideas have already emanated from other sources, nor whether they have been tried out and found technically impracticable. In case they have not yet received a thorough practical consideration, they should receive one in the immediate future.

Let me now come to another point which I believe to merit attention. It has long been clear to me that the modern ultra-rapid computing machine was in principle an ideal central nervous system to an apparatus for automatic control; and that its input and output need not be in the form of numbers or diagrams but might very well be, respectively, the readings of artificial sense organs, such as photoelectric cells or thermometers, and the performance of motors or

solenoids. With the aid of strain gauges or similar agencies to read the performance of these motor organs and to report, to "feed back," to the central control system as an artificial kinesthetic sense, we are already in a position to construct artificial machines of almost any degree of elaborateness of performance. Long before Nagasaki and the public awareness of the atomic bomb, it had occurred to me that we were here in the presence of another social potentiality of unheard-of importance for good and for evil. The automatic factory and the assembly line without human agents are only so far ahead of us as is limited by our willingness to put such a degree of effort into their engineering as was spent, for example, in the development of the technique of radar in the Second World War.¹

I have said that this new development has unbounded possibilities for good and for evil. For one thing, it makes the metaphorical dominance of the machines, as imagined by Samuel Butler, a most immediate and non-metaphorical problem. It gives the human race a new and most effective collection of mechanical slaves to perform its labor. Such mechanical labor has most of the economic properties of slave labor, although, unlike slave labor, it does not involve the direct demoralizing effects of human cruelty. However, any labor that accepts the conditions of competition with slave labor accepts the conditions of slave labor, and is essentially slave labor. The key word of this statement is *competition*. It may very well be a good thing for humanity to have the machine remove from it the need of menial and disagreeable tasks, or it may not. I do not know. It cannot be good for these new potentialities to be assessed in the terms of the market, of the money they save; and it is precisely the terms of the open market, the "fifth freedom," that have become the shibboleth of the sector of American opinion represented by the National Association of Manufacturers and the Saturday Evening Post. I say American opinion, for as an American, I know it best, but the hucksters recognize no national boundary.

Perhaps I may clarify the historical background of the present situation if I say that the first industrial revolution, the revolution of the "dark satanic mills," was the devaluation of the human arm by the competition of machinery. There is no rate of pay at which a United States pick-and-shovel laborer can live which is low enough to compete with the work of a steam shovel as an excavator. The modern industrial revolution is similarly bound to devalue the human brain, at least in its simpler and more routine decisions. Of course, just as the skilled carpenter, the skilled mechanic, the skilled

¹ *Fortune*, 32, 139-147 (October); 163-169 (November, 1945).

dressmaker have in some degree survived the first industrial revolution, so the skilled scientist and the skilled administrator may survive the second. However, taking the second revolution as accomplished, the average human being of mediocre attainments or less has nothing to sell that it is worth anyone's money to buy.

The answer, of course, is to have a society based on human values other than buying or selling. To arrive at this society, we need a good deal of planning and a good deal of struggle, which, if the best comes to the best, may be on the plane of ideas, and otherwise—who knows? I thus felt it my duty to pass on my information and understanding of the position to those who have an active interest in the conditions and the future of labor, that is, to the labor unions. I did manage to make contact with one or two persons high up in the C.I.O., and from them I received a very intelligent and sympathetic hearing. Further than these individuals, neither I nor any of them was able to go. It was their opinion, as it had been my previous observation and information, both in the United States and in England, that the labor unions and the labor movement are in the hands of a highly limited personnel, thoroughly well trained in the specialized problems of shop stewardship and disputes concerning wages and conditions of work, and totally unprepared to enter into the larger political, technical, sociological, and economic questions which concern the very existence of labor. The reasons for this are easy enough to see: the labor union official generally comes from the exacting life of a workman into the exacting life of an administrator without any opportunity for a broader training; and for those who have this training, a union career is not generally inviting; nor, quite naturally, are the unions receptive to such people.

Those of us who have contributed to the new science of cybernetics thus stand in a moral position which is, to say the least, not very comfortable. We have contributed to the initiation of a new science which, as I have said, embraces technical developments with great possibilities for good and for evil. We can only hand it over into the world that exists about us, and this is the world of Belsen and Hiroshima. We do not even have the choice of suppressing these new technical developments. They belong to the age, and the most any of us can do by suppression is to put the development of the subject into the hands of the most irresponsible and most venal of our engineers. The best we can do is to see that a large public understands the trend and the bearing of the present work, and to confine our personal efforts to those fields, such as physiology and psychology, most remote from war and exploitation. As we have seen, there are

those who hope that the good of a better understanding of man and society which is offered by this new field of work may anticipate and outweigh the incidental contribution we are making to the concentration of power (which is always concentrated, by its very conditions of existence, in the hands of the most unscrupulous). I write in 1947, and I am compelled to say that it is a very slight hope.

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Instituto Nacional de Cardiología,
Ciudad de México

November, 1947

*The
Human Use
of Human Beings*



By Norbert Wiener

The "mechanical brain" and similar machines can destroy human values or enable us to realize them as never before. A leader of the new scientific revolution tells how and why.

THE
Human Use
OF Human Beings

CYBERNETICS AND SOCIETY

THE
Human Use
OF Human Beings

CYBERNETICS AND SOCIETY

Norbert Wiener

PROFESSOR OF MATHEMATICS
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body on the spot. If a policy can be thought out in advance, it can be committed to a taping which will regulate the conduct to be followed in accordance with the readings of the instrument. In other words, such factories should be under a régime rather like that of the interlocking signals and switches of the railroad signal-tower. This régime is already followed in oil-cracking factories, in many other chemical works, and in the handling of the sort of dangerous materials found in the exploitation of atomic energy.

We have already mentioned the assembly line as a place for applying the same sorts of technique. In the assembly line, as in the chemical factory or the continuous-process paper mill, it is necessary to exert a certain statistical control on the quality of the product. This control depends on a sampling process. These sampling processes have now been developed by Wald and others into a technique called *sequential analysis*, in which the sampling is no longer taken in a lump, but is a continuous process going along with the production. That which can be done then by a technique so standardized that it can be put in the hands of a statistical computer who does not understand the logic behind it, may also be executed by a computing machine. In other words, except again at the highest levels, the machine takes care of the routine statistical controls, as well as of the production process.

In general, factories have an accounting procedure which is independent of the production. As far as the data which occur in cost-accounting are concerned, that part which comes from the machine or assembly line may be fed directly into the computing machine. Other data may be fed in from time to time by human operators, but the bulk of necessary clerical work will be cut to that not of a completely routine nature. For example, girls will be needed to take care of outside correspondence and the like. Even a large

part of this may be received from the correspondents on punched cards, or transferred to punched cards by extremely low-grade labor. From this stage on, everything may go by machine. This mechanization also may apply to a not inappreciable part of the library and filing facilities of an industrial plant.

In other words, the machine plays no favorites as between overall labor and white collar labor. Thus the possible fields into which the new industrial revolution is likely to penetrate are very extensive; and include all labor performing judgments of a low level, in much the same way as the displaced labor of the earlier industrial revolution included every aspect of human power. There will, of course, be trades into which the new industrial revolution of judgment will not penetrate: either because the new control machines are not economical in industries on so small a scale as not to be able to carry the considerable capital costs involved, or because their work is so varied that a new taping will be necessary for almost every job. I cannot see automatic machinery of the judgment-replacing type coming into use in the corner grocery, or in the corner garage, although I can very well see it employed by the wholesale grocer and the automobile manufacturer. The farm laborer too, although he is beginning to be pressed by automatic machinery, is protected from the full pressure of it, because of the ground he has to cover, the variability of the crops he must till, and the special conditions of weather and the like that he must meet. Even here, the large-scale or plantation farmer is becoming increasingly dependent on cotton-picking and weed-burning machinery, as the wheat farmer has long been dependent on the McCormick reaper. Where such machines may be used, some use of machinery of judgment is not inconceivable.

The introduction of the new devices and the dates at which they are to be expected are, of course, largely economic matters, on which I am not an expert. Short of any violent political changes or another great war, I should give a rough estimate that it will take the new tools ten to twenty years to come into their own. A war would change all this overnight. If we should engage in a war with a major power like Russia, which would make serious demands on the infantry, and consequently on our man-power, we may be hard put to it to keep up our industrial production. Under these circumstances, the matter of replacing human production by other modes may well be a life-or-death matter to the nation. We are already as far along in the process of developing a unified system of automatic control machines as we were in the development of radar in 1939. Just as the emergency of the Battle of Britain made it necessary to attack the radar problem in a massive manner, and to hurry up the natural development of the field by what may have been decades, so too, the needs of labor replacement are likely to act on us in a similar way in the case of another war. The personnel of skilled radio amateurs, mathematicians, and physicists, who were so rapidly turned into competent electrical engineers for the purposes of radar design, is still available for the very similar task of automatic-machine design. There is a new and skilled generation coming up, which they have trained.

Under these circumstances, the period of about two years which it took for radar to get onto the battlefield with a high degree of effectiveness is scarcely likely to be exceeded by the period of evolution of the automatic factory. At the end of such a war, the "know-how" needed to construct such factories will be common. There will even be a considerable backlog of equipment manufactured for the government,

which is likely to be on sale or available to the industrialists. Thus a new war will almost inevitably see the automatic age in full swing within less than five years.

I have spoken of the actuality and the imminence of this new possibility. What can we expect of its economic and social consequences? In the first place, we can expect an abrupt and final cessation of the demand for the type of factory labor performing purely repetitive tasks. In the long run, the deadly uninteresting nature of the repetitive task may make this a good thing, and the source of the leisure which is necessary for the full cultural development of man on all sides. It may also produce cultural results as trivial and wasteful as the greater part of those so far obtained from the radio and the movies.

Be that as it may, the intermediate period of the introduction of the new means, especially if it comes in the fulminating manner to be expected from a new war, will lead to an immediate transitional period of disastrous confusion. We have a good deal of experience as to how the industrialists regard a new industrial potential. Their whole propaganda is to the effect that it must not be considered as the business of the government but must be left open to whatever entrepreneurs wish to invest money in it. We also know that they have very few inhibitions when it comes to taking all the profit out of an industry that there is to be taken, and then letting the public pick up the pieces. This is the history of the lumber and mining industries, and is part of what we have called in another chapter the traditional American philosophy of progress.

Under these circumstances, industry will be flooded with the new tools to the extent that they appear to yield immediate profits, irrespective of what long-time damage they can do. We shall see a process parallel to the way in which the use of atomic energy for bombs has been allowed to

compromise the very necessary potentialities of the long-time use of atomic power to replace our oil and coal supplies, which are within centuries, if not decades, of utter exhaustion. Note well that atomic bombs do not compete with power companies.

Let us remember that the automatic machine, whatever we think of any feelings it may have or may not have, is the precise economic equivalent of slave labor. Any labor which competes with slave labor must accept the economic conditions of slave labor. It is perfectly clear that this will produce an unemployment situation, in comparison with which the present recession and even the depression of the thirties will seem a pleasant joke. This depression will ruin many industries – possibly even the industries which have taken advantage of the new potentialities. However, there is nothing in the industrial tradition which forbids an industrialist to make a sure and quick profit, and to get out before the crash touches him personally.

Thus the new industrial revolution is a two-edged sword. It may be used for the benefit of humanity, assuming that humanity survives long enough to enter a period in which such a benefit is possible. If, however, we proceed along the clear and obvious lines of our traditional behavior, and follow our traditional worship of progress and the fifth freedom – the freedom to exploit – it is practically certain that we shall have to face a decade or more of ruin and despair.

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Norbert Wiener

**I AM A
MATHEMATICIAN**

THE LATER LIFE OF A PRODIGY

I
Am a
Mathematician

The Later Life of a Prodigy

An autobiographical account of
the mature years and career of

Norbert Wiener

and a continuation of the account
of his childhood in *Ex-Prodigy*.



The M.I.T. Press

Massachusetts Institute of Technology
Cambridge, Massachusetts, and London, England

through is nothing but the transfer into action of what was then written in the heavens.

While I had no share in the atomic bomb itself, I was nevertheless led into a very deep searching of soul. I have already explained how my work on prediction and on computing machines had led me to the basis of cybernetics, as I was later to call it, and to an understanding of the possibilities of the automatic factory. From the strictly scientific point of view, this was not as revolutionary as the atomic bomb, but its social possibilities for good and for evil were enormous. I tried to see where my duties led me, and if by any chance I ought to exercise a right of personal secrecy parallel to the right of governmental secrecy assumed in high quarters, suppressing my ideas and the work I had done.

After toying with the notion for some time, I came to the conclusion that this was impossible, for the ideas which I possessed belonged to the times rather than to myself. If I had been able to suppress every word of what I had done, they were bound to reappear in the work of other people, very possibly in a form in which the philosophic significance and the social dangers would be stressed less. I could not get off the back of this bronco, so there was nothing for me to do but to ride it.

I thus decided that I would have to turn from a position of the greatest secrecy to a position of the greatest publicity, and bring to the attention of all the possibilities and dangers of the new developments. I first thought of the trade unions as the people who would naturally be most interested in the matter. My friends directed me towards two union leaders, one of them an intellectual counselor who had himself very little direct authority among the union people with whom he was associated, and the other a high official of the typographers' union. In both cases I found a confirmation of what my English friends had told me some years before: The union official

comes too directly from the workbench, and is too immediately concerned with the difficult and highly technical problems of shop stewardship, to be able to entertain any very forward-looking considerations of the future of his own craft.

I found plenty of good will among my union friends but an absolute block on their part to communicate my ideas to their union workers. This was in the middle forties; since then the situation has changed radically. I have been in repeated communication with Mr. Walter Reuther, of the United Automobile Workers, and I have found in him both an understanding of my problems and a willingness to give my ideas publicity through his union journals. In fact, I have found in Mr. Reuther and the men about him exactly that more universal union statesmanship which I had missed in my first sporadic attempts to make union contacts.

There is another quarter in which the sort of ideas I have had concerning the automatic factory have made gratifying headway. This is in the circles of management itself. In the winter of 1949 I gave a talk to the Society for the Advancement of Management concerning the automatic factory as a technical possibility and the social problems it would introduce, and in both matters I was backed up by high management authorities, as, for example, an executive of Remington Rand, Inc. In December of 1952 I was asked to give a talk on a similar subject as part of a symposium on the automatic factory held by the American Society of Mechanical Engineers.

The progress in the general attitude from the first talk to the second was remarkable. Not only was the attending public much larger and my technical remarks confirmed by automatic-machine men for several industries, but the social consciousness of the group as a whole was far beyond what I had found three years before.

While there were a good many who were more sanguine than I had been as to the possibility of achieving a large meas-

ure of industrial automatization without catastrophe, there was a general awareness of the interest of the public at large in a meeting which was going to affect so profoundly their future method of life. In particular, problems of the grade-up of repetitive factory workers into trouble-shooting men (and indeed into a sort of junior engineer) occupied a great deal of attention.

Another much-debated problem was that of the new leisure we might expect in the future and the use that could and must be made of it. Indeed, I heard hard-boiled engineering administrators express views which sounded remarkably like the writings of William Morris. Above all, I had everyone backing me in cautioning that the new displacement of human beings from the repetitive labor of the factory must not be taken as a devaluation of the human being and a glorification of the gadget.

The years that have passed since this talk have seen the automatic factory develop from a remote possibility into a beginning actuality, and we can start to assess on a factual basis its probable impact on society. The first industrial revolution of the early nineteenth century replaced the individual by the machine as a source of power. No factory worker of the present day is earning any large part of his wages by the horsepower of his output. Even if he is doing the hardest sort of physical labor, as for example, if he is a steel puddler, his pay is not primarily given him as a prime mover in a power process. What he is actually paid for is his experience and knowledge of how to exert his strength most effectively in a highly purposeful manufacturing process.

However, the strong men of industry such as the steel puddlers are in a decided minority. The factory worker finds a small electric motor or a pneumatic tool at his elbow, and these will give him the sheer physical strength of ten men.

His business is to accomplish a certain purpose by going through certain motions in a given succession. If, for example, he is pasting labels on tin cans, he must see that he has the correct stack of labels before him, that he has moistened them correctly, that he has put them in the correct position on the can, and that he turns at the proper time from one can to the next. This sort of laborer goes through a purely repetitive process, making the minimum demands on any but the lowest level of judgment and observation.

Of course, there are other forms of factory labor. There are the foremen and there are the members of the trouble-shooting gangs, who at the very lowest level must be skilled craftsmen and, on the higher levels, are assimilated in their function to junior engineers. Leaving out these higher ranks of labor, the routine factory worker is often doing so conventional a task that every motion of his and the cue for every motion, may be assigned in advance. This is the point of such efficiency systems as the motion study of Taylor and the Gilbreths.

I have already indicated that it is this level of work which will be replaced by the operations of the automatic factory. Essentially, to my way of seeing things, most of the human labor which the automatic factory displaces is an inhuman sort of human labor, which has been considered a natural task for human beings only since the historical accident of the industrial revolution. Nevertheless, any sudden and uncompensated displacement of this labor must have catastrophic consequences in the direction of unemployment.

Where will this labor have to go? The most obvious answer is that even the automatic factory will always require a considerable group of trouble shooters, skilled craftsmen, and specialists in programming or in the adaptation of the machines to specific problems. During a gradual process of automatiza-

tion, the natural place for unskilled factory labor to go is into these higher cadres, by some sort of up-grading. The question of the possibility of this up-grading thus becomes vital.

There is a considerable amount of evidence that the sources of labor which furnished the unskilled factory labor of the past generation are drying up, because, since soon after the end of the First World War, we have had no extensive body of immigrants seeking to establish and settle themselves in the country and willing to accept any degree of economic undervaluing. It is the children of this last extensive generation of immigrants who fought in the Second World War, and the rising generation of the present day consists of their children's children. These younger generations are unwilling to accept the permanent position of economic inferiority belonging to the unskilled workers in the old type of factory. Many of them are going into the professions, and even those who are not are beginning to demand that their work be interesting and not a blind alley.

This is not the first time in our industrial history in which technical advances have been conditioned by the decreasing availability of labor of a certain type. Automatic telephone switching came in simply because the old system of hand switching bade fair to demand the entire population of girl high school graduates.

Another matter which may make the stepping up of labor easier than it might have seemed a few years ago is the training of a very considerable part of the young men in our military services as technicians of a relatively high grade. This has been particularly the case in the Air Force. The sort of young man who can be trained to direct and to care for a radar instrument is certainly the sort who can easily learn to be a member of a factory trouble-shooting gang.

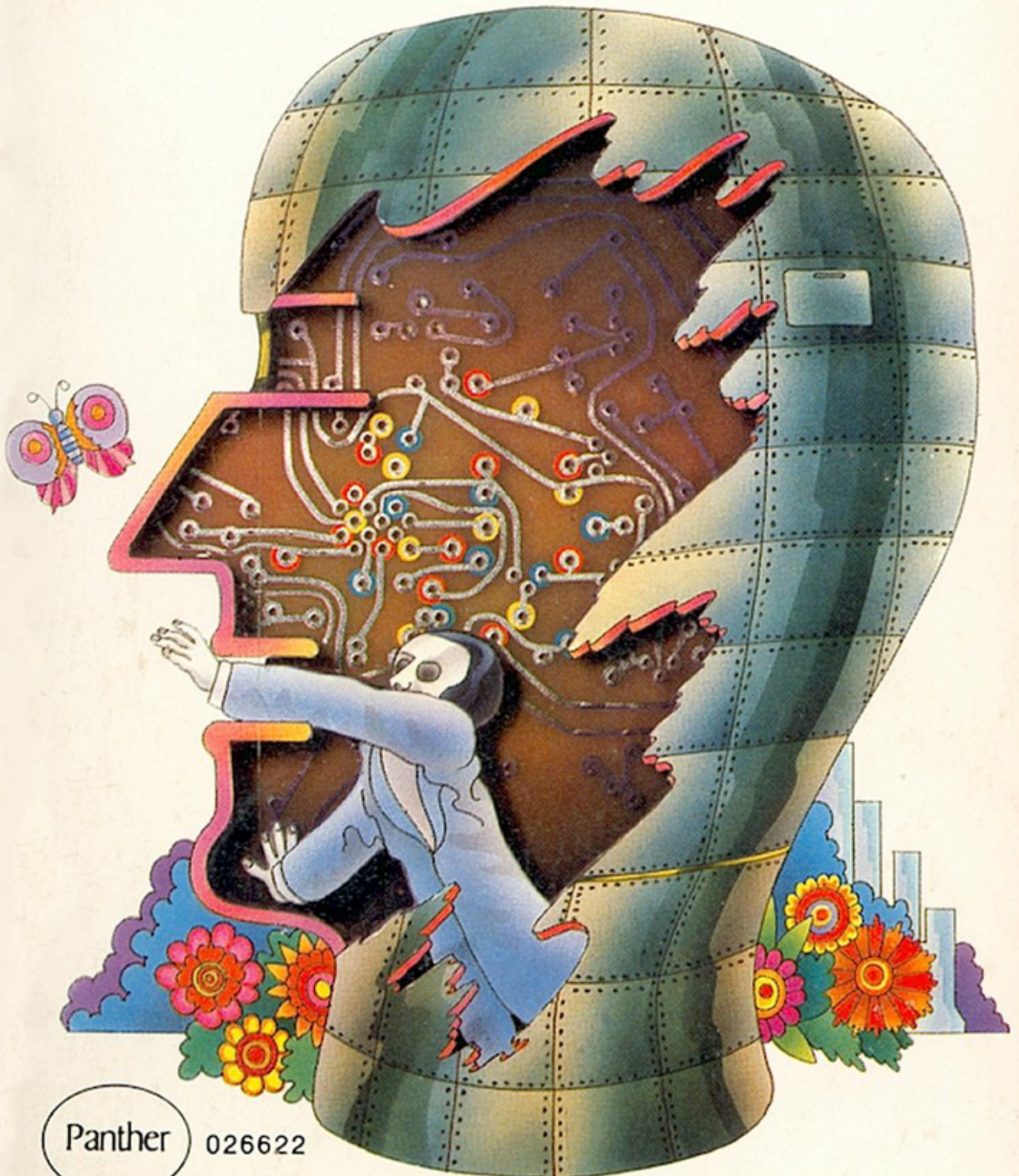
Thus it is quite possible, although it is not certain, that the labor environment for the automatic factory has come just

at the right time. At any rate, the atmosphere into which the automatic factory is coming is one where it fits into a definite niche of human activity, and one which has been alerted to both the advantages of automatization and the risks.

While this has been the work of many hands, I feel proud that some part of the healthy and understanding atmosphere into which automatization is coming, and of the collaboration of labor and management in being prepared to work out jointly a mode of industrial life which embraces the automatic factory, may be due to my early efforts to alert both of these elements.

Player Piano

The great sf classic by
Kurt Vonnegut Jr.



CONSIDER THE LILLIES OF THE FIELD, HOW THEY GROW:
THEY TOIL NOT, NEITHER DO THEY SPIN;
AND YET I SAY UNTO YOU,
THAT EVEN SOLOMON IN ALL HIS GLORY
WAS NOT ARRAYED LIKE ONE OF THESE . . .

MATTHEW 6:28

Foreword

This book is not a book about what is, but a book about what could be. The characters are modeled after persons as yet unborn, or, perhaps, at this writing, infants.

It is mostly about managers and engineers. At this point in history, 1952 a.d., our lives and freedom depend largely upon the skill and imagination and courage of our managers and engineers, and I hope that God will help them to help us

all stay alive and free.

But this book is about another point in history, when there is no more war, and . . .

CHAPTER ONE

Ilium, New York, is divided into three parts.

In the northwest are the managers and engineers and civil servants and a few professional people; in the northeast are the machines; and in the south, across the Iroquois River, is the area known locally as Homestead, where almost all of the people live.

If the bridge across the Iroquois were dynamited, few daily routines would be disturbed. Not many people on either side have reasons other than curiosity for crossing.

During the war, in hundreds of Iliums over America, managers and engineers learned to get along without their men and women, who went to fight. It was the miracle that won the war - production with almost no manpower. In the patois of the north side of the river, it was the know-how that won the war. Democracy owed its life to know-how.

Ten years after the war - after the men and women had come home, after the riots had been put down, after thousands had been jailed under the antisabotage

laws - Doctor Paul Proteus was petting a cat in his office. He was the most important, brilliant person in Ilium, the manager of the Ilium Works, though only thirty-five. He was tall, thin, nervous, and dark, with the gentle good looks of his long face distorted by dark-rimmed glasses.

He didn't feel important or brilliant at the moment, nor had he for some time. His principle concern just then was that the black cat be contented in its new surroundings.

Those old enough to remember and too old to compete said affectionately that Doctor Proteus looked just as his father had as a young man - and it was generally understood, resentfully in some quarters, that Paul would someday rise almost as high in the organization as his father had. His father, Doctor George Proteus, was at the time of his death the nation's first National Industrial, Commercial, Communications, Foodstuffs, and Resources Director, a position approached in importance only by the presidency of the United States.

As for the Proteus genes' chances of being passed down to yet another generation, there were practically none. Paul's wife, Anita, his secretary during the war, was barren. Ironically as anyone would please, he had married her after she had declared that she was certainly pregnant, following an abandoned office celebration of victory.

"Like that, kitty?" With solicitousness and vicarious pleasure, young Proteus ran a roll of blueprints along the cat's arched back. "Mmmmm-aaaaah - good, eh?" He had spotted her that morning, near the golf course, and had picked her up as a mouser for the plant. Only the night before, a mouse had gnawed through the insulation on a control wire and put buildings 17, 19, and 21 temporarily out of commission.

Paul turned on his intercom set. "Katharine?"

"Yes, Doctor Proteus?"

"Katharine, when's my speech going to be typed?"

"I'm doing it now, sir. Ten, fifteen minutes, I promise."

Doctor Katharine Finch was his secretary, and the only woman in the Ilium Works. Actually, she was more a symbol of rank than a real help, although she was useful as a stand-in when Paul was ill or took a notion to leave work early. Only the brass - plant managers and bigger - had secretaries. During the war, the managers and engineers had found that the bulk of secretarial work could be done - as could most lower-echelon jobs - more quickly and efficiently and cheaply by machines. Anita was about to be dismissed when Paul had married her. Now, for instance, Katharine was being annoyingly unmachine-like, dawdling over Paul's speech, and talking to her presumed lover, Doctor Bud Calhoun, at the same time.

Bud, who was manager of the petroleum terminal in Ilium, worked only when shipments came or went by barge or pipeline, and he spent most of his time between these crises - as now - filling Katharine's ears with the euphoria of his Georgia sweet talk.

Paul took the cat in his arms and carried her to the enormous floor-to-ceiling window that comprised one wall. "Lots and lots of mice out there, kitty," he said.

He was showing the cat an old battlefield at peace. Here, in the basin of the river bend, the Mohawks had overpowered the Algonquins, the Dutch the Mohawks, the British the Dutch, the Americans the British. Now, over bones and rotten palings and cannon balls and arrowheads, there lay a triangle of steel and masonry buildings, a half-mile on each side the Ilium Works. Where men had once howled and hacked at one another, and fought nip-and-tuck with nature as well, the machines hummed and whirred and clicked, and made parts for baby carriages and bottle caps, motorcycles and refrigerators, television sets and tricycles - the fruits of peace.

Paul raised his eyes above the rooftops of the great triangle to the glare of the sun on the Iroquois River, and beyond - to Homestead, where many of the pioneer names still lived: van Zandt, Cooper, Cortland, Stokes . . .

"Doctor Proteus?" It was Katharine again.

"Yes, Katharine."

"It's on again."

"Three in Building 58?"

"Yessir - the light's on again."

"All right - call Doctor Shepherd and find out what he's doing about it."

"He's sick today. Remember?"

"Then it's up to me, I guess." He put on his coat, sighed with ennui, picked up the cat, and walked into Katharine's office. "Don't get up, don't get up," he said to Bud, who was stretched out on a couch.

"Who was gonna get up?" said Bud.

Three walls of the room were solid with meters from baseboard to molding, unbroken save for the doors leading into the outer hall and into Paul's office. The fourth wall, as in Paul's office, was a single pane of glass. The meters were identical, the size of cigarette packages, and stacked like masonry, each labeled with a bright brass plate. Each was connected to a group of machines somewhere in the Works. A glowing red jewel called attention to the seventh meter from the bottom, fifth row to the left, on the east wall.

Paul tapped the meter with his finger. "Uh-huh - here we go again: number three in 58 getting rejects, all right." He glanced over the rest of the instruments. "Guess that's all, eh?"

"Just that one."

"Whatch goin' do with thet cat?" said Bud.

Paul snapped his fingers. "Say, I'm glad you asked that. I have a project for you, Bud. I want some sort of signaling device that will tell this cat where she can find a mouse."

"Electronic?"

"I should hope so."

"You'd need some kind of sensin' element that could smell a mouse."

"Or a rat. I want you to work on it while I'm gone."

As Paul walked out to his car in the pale March sunlight, he realized that Bud Calhoun *would* have a mouse alarm designed - one a cat could understand - by the time he got back to the office. Paul sometimes wondered if he wouldn't have been more content in another period of history, but the rightness of Bud's being alive now was beyond question. Bud's mentality was one that had been remarked upon as being peculiarly American since the nation had been born - the restless, erratic insight and imagination of a gadgeteer. This was the climax, or close to it, of generations of Bud Calhouns, with almost all of American industry integrated into one stupendous Rube Goldberg machine.

Paul stopped by Bud's car, which was parked next to his. Bud had shown off its special features to him several times, and, playfully, Paul put it through its paces. "Let's go," he said to the car.

A whir and a click, and the door flew open. "Hop in," said a tape recording under the dashboard. The starter spun, the engine caught and idled down, and the radio went on.

Gingerly, Paul pressed a button on the steering column. A motor purred, gears grumbled softly, and the two front seats lay down side by side like sleepy lovers. It struck Paul as shockingly like an operating table for horses he had once seen in a veterinary hospital - where the horse was walked alongside the tipped table, lashed

to it, anesthetized, and then toppled into operating position by the gear-driven table top. He could see Katharine Finch sinking, sinking, sinking, as Bud, his hand on the button, crooned. Paul raised the seats with another button. "Goodbye," he said to the car.

The motor stopped, the radio winked off, and the door slammed. "Don't take any wooden nickels," called the car as Paul climbed into his own. "Don't take any wooden nickels, don't take any wooden nickels, don't take any -"

"I won't!"

Bud's car fell silent, apparently at peace.

Paul drove down the broad, clean boulevard that split the plant, and watched the building numbers flash by. A station wagon, honking its horn, and its occupants waving to him, shot past in the opposite direction, playfully zigzagging on the deserted street, heading for the main gate. Paul glanced at his watch. That was the second shift just coming off work. It annoyed him that sophomoric high spirits should be correlated with the kind of young men it took to keep the plant going. Cautiously, he assured himself that when he, Finnerty, and Shepherd had come to work in the Ilium Works thirteen years before, they had been a good bit more adult, less cock-sure, and certainly without the air of belonging to an elite.

Some people, including Paul's famous father, had talked in the old days as though engineers, managers, and scientists were an elite. And when things were building up to the war, it was recognized that American know-how was the only answer to the prospective enemy's vast numbers, and there was talk of deeper, thicker shelters for the possessors of know-how, and of keeping this cream of the population out of the front-line fighting. But not many had taken the idea of an elite to heart. When Paul, Finnerty, and Shepherd had graduated from college, early in the war, they had felt sheepish about not going to fight, and humbled by those who did go. But now this elite business, this assurance of superiority, this sense of rightness about the hierarchy topped by managers and engineers - this was instilled in all college graduates, and there were no bones about it.

Paul felt better when he got into Building 58, a long, narrow structure four blocks long. It was a pet of his. He'd been told to have the north end of the building torn down and replaced, and he'd talked Headquarters out of it. The north end was the oldest building in the plant, and Paul had saved it - because of its historical interest to visitors, he'd told Headquarters. But he discouraged and disliked visitors, and he'd really saved Building 58's north end for himself. It was the original machine shop set up by Edison in 1886, the same year in which he opened another in Schenectady, and visiting it took the edge off Paul's periods of depression. It was a vote of confidence from the past, he thought - where the past admitted how humble and shoddy it had been, where one could look from the old to the new and see that mankind really had come a long way. Paul needed that reassurance from time to time.

Objectively, Paul tried to tell himself, things really were better than ever. For once, after the great bloodbath of the war, the world really was cleared of unnatural terrors - mass starvation, mass imprisonment, mass torture, mass murder. Objectively, know-how and world law were getting their long-awaited chance to turn earth into an altogether pleasant and convenient place in which to sweat out Judgment Day.

Paul wished he had gone to the front, and heard the senseless tumult and thunder, and seen the wounded and dead, and maybe got a piece of shrapnel through his leg. Maybe he'd be able to understand then how good everything now was by comparison, to see what seemed so clear to others - that what he was doing, had done, and would do as a manager and engineer was vital, above reproach, and had, in fact, brought on a golden age. Of late, his job, the system, and organizational politics had left him variously annoyed, bored, or queasy.

He stood in the old part of Building 58, which was now filled with welding machines and a bank of insulation braiders. It soothed him to look up at the wooden rafters, uneven with ancient adze marks beneath flaking calcimine, and at the dull walls of brick soft enough for men - God knows how long ago - to carve their initials in: "KTM," "DG," "GP," "BDH," "HB," "NNS." Paul imagined for a moment - as he often imagined on visits to Building 58 - that he was Edison,

standing on the threshold of a solitary brick building on the banks of the Iroquois, with the upstate winter slashing through the broomcorn outside. The rafters still bore the marks of what Edison had done with the lonely brick barn: bolt holes showed where overhead shafts had once carried power to a forest of belts, and the wood-block floor was black with the oil and scarred by the feet of the crude machines the belts had spun.

On his office wall, Paul had a picture of the shop as it had been in the beginning. All of the employees, most of them recruited from surrounding farms, had stood shoulder to shoulder amid the crude apparatus for the photograph, almost fierce with dignity and pride, ridiculous in stiff collars and derbies. The photographer had apparently been accustomed to taking pictures of athletic teams and fraternal organizations, for the picture had the atmosphere, after the fashion of the day, of both. In each face was a defiant promise of physical strength, and at the same time, there was the attitude of a secret order, above and apart from society by virtue of participating in important and moving rites the laity could only guess about - and guess wrong. The pride in strength and important mystery showed no less in the eyes of the sweepers than in those of the machinists and inspectors, and in those of the foreman, who alone was without a lunchbox.

A buzzer sounded, and Paul stepped to one side of the aisle as the sweeping machine rattled by on its rails, whooshing up a cloud of dust with spinning brooms, and sucking up the cloud with a voracious snout. The cat in Paul's arms clawed up threads from his suit and hissed at the machine.

Paul's eyes began to nag him with a prickling sensation, and he realized that he'd been gazing into the glare and sputter of the welding machines without protecting his eyes. He clipped dark glasses over his spectacles, and strode through the antiseptic smell of ozone toward lathe group three, which was in the center of the building, in the new part.

He paused for a moment by the last welding-machine group, and wished Edison could be with him to see it. The old man would have been enchanted. Two steel plates were stripped from a pile, sent rattling down a chute; were seized by

mechanical hands and thrust under the welding machine. The welding heads dropped, sputtered, and rose. A battery of electric eyes balefully studied the union of the two plates, signaled a meter in Katharine's office that all was well with welding-machine group five in Building 58, and the welded plates skittered down another chute into the jaws of the punch-press group in the basement. Every seventeen seconds, each of the twelve machines in the group completed the cycle.

Looking the length of Building 58, Paul had the impression of a great gymnasium, where countless squads practiced precision calisthenics - bobbing, spinning, leaping, thrusting, waving. . . . This much of the new era Paul loved: the machines themselves were entertaining and delightful.

Cursorily, he opened the control box for the welding-machine group, and saw that the machines were set to run for three more days. After that, they would shut down automatically until Paul received new orders from headquarters and relayed them to Doctor Lawson Shepherd, who was second-in-command and responsible for Buildings 53 through 71. Shepherd, who was sick today, would then set the controls for a new batch of refrigerator backs - however many backs EPICAC, a computing machine in Carlsbad Caverns, felt the economy could absorb.

Paul, calming the anxious cat with his long, slender fingers, wondered indifferently if Shepherd really was sick. Probably not. More likely, he was seeing important people, trying to get transferred out from under Paul.

Shepherd, Paul, and Edward Finnerty had all come to Ilium together as youngsters. Now Finnerty had moved on to bigger things in Washington; Paul had been given the highest job in Ilium; and Shepherd, sulky and carping, but efficient, had, in his own eyes, been humiliated by being named second-in-command to Paul. Transfers were an upper-echelon decision, and Paul hoped to God that Shepherd got one.

Paul arrived at lathe group three, the troublemaker he had come to see. He had been agitating a long time for permission to junk the group, without much luck. The lathes were of the old type, built originally to be controlled by men, and

adapted during the war, clumsily, to the new techniques. The accuracy was going out of them, and, as the meter in Katharine's office had pointed out, rejects were showing up in quantity. Paul was willing to bet that the lathe group was ten per cent as wasteful as it had been in the days of human control and mountainous scrap heaps.

The group, five ranks of ten machines each, swept their tools in unison across steel bars, kicked out finished shafts onto continuous belts, stopped while raw bars dropped between their chucks and tailstocks, clamped down, and swept their tools across the bars, kicked out the finished shafts onto . . .

Paul unlocked the box containing the tape recording that controlled them all. The tape was a small loop that fed continuously between magnetic pickups. On it were recorded the movements of a master machinist turning out a shaft for a fractional horsepower motor. Paul counted back - eleven, twelve, thirteen years ago, he'd been in on the making of the tape, the master from which this one had been made. . . .

He and Finnerty and Shepherd, with the ink hardly dry on their doctorates, had been sent to one of the machine shops to make the recording. The foreman had pointed out his best man - what *was* his name? - and, joking with the puzzled machinist, the three bright young men had hooked up the recording apparatus to the lathe controls. Hertz! That had been the machinist's name - Rudy Hertz, an old-timer, who had been about ready to retire. Paul remembered the name now, and remembered the deference the old man had shown the bright young men.

Afterward, they'd got Rudy's foreman to let him off, and, in a boisterous, whimsical spirit of industrial democracy, they'd taken him across the street for a beer. Rudy hadn't understood quite what the recording instruments were all about, but what he had understood, he'd liked: that he, out of thousands of machinists, had been chosen to have his motions immortalized on tape.

And here, now, this little loop in the box before Paul, here was Rudy as Rudy had been to his machine that afternoon - Rudy, the turner-on of power, the setter

of speeds, the controller of the cutting tool. This was the essence of Rudy as far as his machine was concerned, as far as the economy was concerned, as far as the war effort had been concerned. The tape was the essence distilled from the small, polite man with the big hands and black fingernails; from the man who thought the world could be saved if everyone read a verse from the Bible every night; from the man who adored a collie for want of children; from the man who . . . What else had Rudy said that afternoon? Paul supposed the old man was dead now - or in his second childhood in Homestead.

Now, by switching in lathes on a master panel and feeding them signals from the tape, Paul could make the essence of Rudy Hertz produce one, ten, a hundred, or a thousand of the shafts.

Paul closed the box's door. The tape seemed in good condition, and so were the pickups. Everything, in fact, was as ship-shape as could be expected, considering the antiquity of the machines. There were just going to have to be rejects, and that was that. The whole group belonged in a museum, not a production setup. Even the box was archaic - a vaultlike affair bolted to the floor, with a steel door and lock. At the time of the riots, right after the war, the master tapes had all been locked up in this way. Now, with the antisabotage laws as rigidly enforced as they were, the only protection the controls needed was from dust, cockroaches, and mice.

At the door, in the old part of the building once more, Paul paused for a moment to listen to the music of Building 58. He had had it in the back of his mind for years to get a composer to do something with it - *the Building 58 Suite*. It was wild and Latin music, hectic rhythms, fading in and out of phase, kaleidoscopic sound. He tried to separate and identify the themes. There! The lathe groups, the tenors: "*Furrazz-ow-ow-ow-ow-ow-ak! ting! Furr-azz-ow-ow . . .*" The welders, the baritones: "*Vaaaaaaa-zuzip! Vaaaaaaa-zuzip!*" And, with the basement as a resonating chamber, the punch presses, the basses: "*Aw-grumph! tonka-tonka. Aw-grump! tonka-tonka . . .*" It was exciting music, and Paul, flushed, his vague anxieties gone, gave himself over to it.

Out of the corner of his eye, a crazy, spinning movement caught his fancy, and he turned in his delight to watch a cluster of miniature maypoles braid bright cloth insulation about a black snake of cable. A thousand little dancers whirled about one another at incredible speeds, pirouetting, dodging one another, unerringly building their snug snare about the cable. Paul laughed at the wonderful machines, and had to look away to keep from getting dizzy. In the old days, when women had watched over the machines, some of the more simple-hearted had been found sitting rigidly at their posts, staring, long after quitting time.

His gaze fell upon an asymmetrical heart scratched into the old brick, and in its center, "K.L.-M.W.", and the date, "1931." K.L. and M.W. had taken a liking to one another, then, in the same year that Edison had died. Paul thought again of the fun of showing the old man around Building 58, and suddenly realized that most of the machinery would be old stuff, even to Edison. The braiders, the welders, the punch presses, the lathes, the conveyers - everything in sight, almost, had been around in Edison's time. The basic parts of the automatic controls, too, and the electric eyes and other elements that did and did better what human senses had once done for industry - all were familiar enough in scientific circles even in the nineteen-twenties. All that was new was the combination of these elements. Paul reminded himself to bring that out in his talk at the Country Club that night.

The cat arched her back and clawed at Paul's suit again. The sweeper was snuffling down the aisle toward them once more. It sounded its warning buzzer, and Paul stepped out of its path. The cat hissed and spat, suddenly raked Paul's hand with her claws, and jumped. With a bouncing, stiff-legged gait, she fled before the sweeper. Snatching, flashing, crashing, shrieking machines kept her in the middle of the aisle, yards ahead of the sweeper's whooshing brooms. Paul looked frantically for the switch that would stop the sweeper, but before he found it, the cat made a stand. She faced the oncoming sweeper, her needle-like teeth bared, the tip of her tail snapping back and forth. The flash of a welder went off inches from her eyes, and the sweeper gobbled her up and hurled her squalling and scratching into its galvanized tin belly.

Winded after a quarter-mile run through the length of the building, Paul caught

the sweeper just as it reached a chute. It gagged, and spat the cat down the chute and into a freight car outside. When Paul got outside, the cat had scrambled up the side of the freight car, tumbled to the ground, and was desperately clawing her way up a fence.

"No, kitty, no!" cried Paul.

The cat hit the alarm wire on the fence, and sirens screamed from the gate house. In the next second the cat hit the charged wires atop the fence. A pop, a green flash, and the cat sailed high over the top strand as though thrown. She dropped to the asphalt - dead and smoking, but outside.

An armored car, its turret nervously jerking its brace of machine guns this way and that, grumbled to a stop by the small corpse. The turret hatch clanged open, and a plant guard cautiously raised his head. "Everything all right, sir?"

"Turn off the sirens. Nothing but a cat on the fence." Paul knelt, and looked at the cat through the mesh of the fence, frightfully upset. "Pick up the cat and take her to my office."

"Beg your pardon, sir?"

"The cat - I want her taken to my office."

"She's dead, sir."

"You heard me."

"Yessir."

Paul was in the depths again as he climbed into his car in front of Building 58. There was nothing in sight to divert him, nothing but asphalt, a perspective of blank, numbered façades, and wisps of cold cirrus clouds in a strip of blue sky. Paul glimpsed the only life visible through a narrow canyon between Buildings 57 and 59, a canyon that opened onto the river and revealed a bank of gray porches in

Homestead. On the topmost porch an old man rocked in a patch of sunlight. A child leaned over the railing and launched a square of paper in a lazy, oscillating course to the river's edge. The youngster looked up from the paper to meet Paul's gaze. The old man stopped rocking and looked, too, at the curiosity, a living thing in the Ilium Works.

As Paul passed Katharine Finch's desk on his way into his office, she held out his typewritten speech. "That's very good, what you said about the Second Industrial Revolution," she said.

"Old, old stuff."

"It seemed very fresh to me - I mean that part where you say how the First Industrial Revolution devalued muscle work, then the second one devalued routine mental work. I was fascinated."

"Norbert Wiener, a mathematician, said all that way back in the nineteen-forties. It's fresh to you because you're too young to know anything but the way things are now."

"Actually, it is kind of incredible that things were ever any other way, isn't it? It was so ridiculous to have people stuck in one place all day, just using their senses, then a reflex, using their senses, then a reflex, and not really thinking at all."

"Expensive," said Paul, "and about as reliable as a putty ruler. You can imagine what the scrap heap looked like, and what hell it was to be a service manager in those days. Hangovers, family squabbles, resentments against the boss, debts, the war - every kind of human trouble was likely to show up in a product one way or another." He smiled. "And happiness, too. I can remember when we had to allow for holidays, especially around Christmas. There wasn't anything to do but take it. The reject rate would start climbing around the fifth of December, and up and up it'd go until Christmas. Then the holiday, then a horrible reject rate; then New Year's, then a ghastly reject level. Then things would taper down to normal - which was plenty bad enough - by January fifteenth or so. We used to have to figure in things like that in pricing a product."

"Do you suppose there'll be a Third Industrial Revolution?"

Paul paused in his office doorway. "A third one? What would that be like?"

"I don't know exactly. The first and second ones must have been sort of inconceivable at one time."

"To the people who were going to be replaced by machines, maybe. A third one, eh? In a way, I guess the third one's been going on for some time, if you mean thinking machines. That would be the third revolution, I guess - machines that devalue human thinking. Some of the big computers like EPICAC do that all right, in specialized fields."

"Uh-huh," said Katharine thoughtfully. She rattled a pencil between her teeth. "First the muscle work, then the routine work, then, maybe, the real brainwork."

"I hope I'm not around long enough to see that final step. Speaking of industrial revolutions, where's Bud?"

"A barge was coming in, so he had to get back to work. He left this for you." She handed him a crumpled laundry slip with Bud's name on it.

Paul turned the slip over and found, as he had expected, a circuit diagram for a mouse detector and alarm system that might very well work. "Astonishing mind, Katharine."

She nodded uncertainly.

Paul closed his door, locked it silently, and got a bottle from under papers in a bottom drawer. He blacked out for an instant under the gloriously hot impact of a gulp of whisky. He hid the bottle again, his eyes watering.

"Doctor Proteus, your wife is on the phone," said Katharine on the intercom.

"Proteus speaking." He started to sit, and was distressed to find a small wicker basket in his chair, containing a dead black cat.

"This is me, darling, Anita."

"Hello, hello, hello." He set the basket on the floor gently, and sank into his chair. "How are you, sweetheart?" he said absently. His mind was still on the cat.

"All set to have a good time tonight?" It was a theatrical contralto, knowing and passionate: Ilium's Lady of the Manor speaking.

"Been jumpy all day about the talk."

"Then you'll do it brilliantly, darling. You'll get to Pittsburgh yet. I haven't the slightest doubt about that, Paul, not the slightest. Just wait until Kroner and Baer hear you tonight."

"Kroner and Baer accepted, did they?" These two were manager and chief engineer, respectively, of the entire Eastern Division, of which the Ilium Works was one small part. It was Kroner and Baer who would decide who was to get the most important job in their division, a job left vacant two weeks ago by death - the managership of the Pittsburgh Works. "How gay can a party get?"

"Well, if you don't like that, I have some news you will like. There's going to be another very special guest."

"Hi ho."

"And you have to go to Homestead for some Irish whisky for him. The club hasn't got any."

"Finnerty! Ed Finnerty!"

"Yes, Finnerty. He called this afternoon and was very specific about your getting some Irish for him. He's on his way from Washington to Chicago, and he's

going to stop off here."

"How long has it been, Anita? Five, six years?"

"Not since before you got to be manager. *That* long." She was hale, enthusiastic about Finnerty's coming. It annoyed Paul, because he knew very well that she didn't care for Finnerty. She was crowing, not because she was fond of Finnerty but because she enjoyed the ritual attitudes of friendships, of which she had none. Also, since he'd left Ilium, Ed Finnerty had become a man of consequence, a member of the National Industrial Planning Board; and this fact no doubt dulled her recollections of contretemps with Finnerty in the past.

"You're right about that being good news, Anita. It's wonderful. Takes the edge off Kroner and Baer."

"Now, you're going to be nice to them, too."

"Oh yes. Pittsburgh, here we come."

"If I tell you something for your own good, promise not to get mad?"

"No."

"All right, I'll tell you anyway. Amy Halporn said this morning she'd heard something about you and Pittsburgh. Her husband was with Kroner today, and Kroner had the impression that you didn't *want* to go to Pittsburgh."

"How does he want me to tell him - in Esperanto? I've told him I wanted the job a dozen different ways in English."

"Apparently Kroner doesn't feel you really mean it. You've been too subtle and modest, darling."

"Kroner's a bright one, all right."

"How do you mean?"

"I mean he's got more insight into me than I do."

"You mean you don't want the Pittsburgh job?"

"I'm not sure. He apparently knew that before I did."

"You're tired, darling."

"I guess."

"You need a drink. Come home early."

"All right."

"I love you, Paul."

"I love *you*, Anita. Goodbye."

Anita had the mechanics of marriage down pat, even to the subtlest conventions. If her approach was disturbingly rational, systematic, she was thorough enough to turn out a creditable counterfeit of warmth. Paul could only suspect that her feelings were shallow - and perhaps that suspicion was part of what he was beginning to think of as his sickness.

His head was down, his eyes closed, when he hung up. When he opened his eyes, he was looking at the dead cat in the basket.

"Katharine!"

"Yessir."

"Will you have somebody bury this cat."

"We wondered what you wanted to do with it."

"God knows what I had in mind." He looked at the corpse and shook his head. "God knows. Maybe a Christian burial; maybe I hoped she'd come around. Get rid of it right away, would you?"

He stopped by Katharine's desk on his way home and told her not to worry about the glowing jewel on the seventh meter from the bottom, fifth row from the left, on the east wall.

"Beyond help," he said. Lathe group three, Building 58, had been good in its day, but was showing wear and becoming a misfit in the slick, streamlined setup, where there was no place for erratic behavior. "Basically, it wasn't built for the job it's doing anyway. I look for the buzzer to go off any day now, and that'll be the end."

In each meter box, in addition to the instrument, the jewel, and the warning lamp, was a buzzer. The buzzer was the signal for a unit's complete breakdown.

CHAPTER TWO

The Shah of Bratpuhr, spiritual leader of 6,000,000 members of the Kolhourri sect, wizened and wise and dark as cocoa, encrusted with gold brocade and constellations of twinkling gems, sank deep into the royal-blue cushions of the limousine - like a priceless brooch in its gift box.

On the other side of the limousine's rear seat sat Doctor Ewing J. Halyard, of the United States Department of State, a heavy, florid, urbane gentleman of forty. He wore a flowing sandy mustache, a colored shirt, a boutonniere, and a waistcoat