Norbert Wiener's Vision: The Impact of "the Automatic Age" on Our Moral Lives

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Foreseeing the Information Age

During the Second World War, while working to design a new kind of antiaircraft cannon, mathema-tician Norbert Wiener and several of his colleagues developed a new branch of applied science — the science of information feedback systems — which Wiener named "cybernetics". With impressive foresight, Wiener realized that this new science, when combined with the electronic digital computers that were being developed to support the war effort, had enormous social and ethical implications. Soon after the Second World War, therefore, Wiener began to write and lecture about the social and ethical challenges of the coming "automatic age", which he also called "the second industrial revolution". As early as 1948, in his book *Cybernetics: or Control and Communication in the Animal and the Machine*, Wiener published the following comments:

> 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. . . . 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. (Wiener, 1948, p.36)

> 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. . . . The modern industrial revolution [i.e., the computer revolution] is similarly bound to devalue the human brain. . . . The answer, of course, is to have a society based on human values other than buying and selling. To arrive at this society, we need a good deal of planning and a good deal of struggle. . . . (Wiener, 1948, pp. 37-38, bracketed words added)

In his writings on the social and ethical impact of the coming "automatic age", Wiener examined ways in which information and communication technology could affect — both positively and negatively — *fundamental human values*, such as life and health, work and wealth, knowledge and ability, creativity and happiness, democracy and freedom, peace and security.

Wiener's groundbreaking research on the ethical implications of "the modern ultra-rapid computing machine" and related technologies established him as a seminal figure in the applied ethics field that, today, is variously called "computer ethics", "information ethics", or "ICT ethics" (information and communication technology ethics). "*Information ethics*" is perhaps the most appropriate name for Wiener's field of ethical research, because it concerned all means of storing, transmitting and processing information, including, for example, perception, memory, printing, phonographs, telephones, telegraph, radio, television, computers, and so on. (Henceforth, in the present essay, the term "information ethics"[1] will be used to refer to the applied ethics field that Wiener founded.)

The central importance of information in a human life, from Wiener's point of view, is revealed in the following quotation from his book *The Human Use of Human Beings: Cybernetics and Society*[2]:

> Information is a name for the content of what is exchanged with the outer world as we adjust to it, and make our adjustment felt upon it. The process of receiving and of using information is the process of our adjusting to the contingencies of the outer environment, and of our living effectively within that environment. The needs and the complexity of modern life make greater demands on this process of information than ever before. . . . To live effectively is to live with

[1] For several contemporary works on information ethics, see the recent writings of Luciano Floridi listed in the References below.

[2] First published in 1950 by Houghton Mifflin. In 1954, Doubleday Anchor published a significantly revised version. In the present essay, all quotations from *The Human Use of Human Beings* are from the 1954 version.

> adequate information. Thus, communication and control belong to the essence of man's inner life, even as they belong to his life in society. (Wiener, 1954, pp. 17-18)

An Aristotelian Foundation for Information Ethics

In creating the field of information ethics, Wiener laid down a foundation that is very Aristotelian.[3] Although there is no evidence that he explicitly based himself upon Aristotle, the similarities are striking between Aristotle's accounts of animal behavior and human action on the one hand, and Wiener's explanations of animal behavior, human action, and machine agency on the other hand. Both Aristotle and Wiener described animals, including humans, as information processing beings that take in information from the outside world through their sense organs, process and store that information in ways dependent upon the specific structure of their bodies, and adjust their behavior to take account of past experiences and new information. And like Aristotle before him, Wiener saw an intimate relationship between the *information processing* nature of human beings and the *purpose* of a human life. For Wiener as for Aristotle, the overall purpose of a human life is to *flourish* as a creating, adapting, perceiving, learning, thinking, reasoning being empowered by sophisticated internal information processing. (Aristotle called it "theoretical and practical reasoning".)

The ability of human beings to flourish in this way, according to Wiener, is dependent upon human physiology. To emphasize this point, Wiener often compared the bodies of humans with those of other animals like insects:

> I wish to show that the human individual, capable of vast learning and study, which may occupy about half of his life, is physically equipped, as the ant is not, for this capacity. Variety and possibility are inherent in the human sensorium — and indeed are the key to man's most noble flights — because variety and possibility belong to the very structure of the human organism. (Wiener, 1954, pp. 51-52)

> *Cybernetics takes the view that the structure of the machine or of the organism is an index of the performance that may be expected from it.* The fact that the mechanical rigidity of the insect is such as to limit its intelligence while the mechanical fluidity of the human being provides for his almost indefinite intellectual expansion is highly relevant to the point of view of this book. (Wiener, 1954, p. 57, italics in the original)

Entropy and Purpose in a Human Life

Like Aristotle, Wiener used the science of his day to help understand human nature and to derive an account of purpose in a human life. Of course, the science in Aristotle's time was his own biology and physics,[4] while that of Wiener included late 19th and early 20th century sciences like thermodynamics, statistical mechanics and Darwinian biology. Of special interest to Wiener was the second law of thermodynamics and the associated concept of *entropy* because these are closely related to information. As Wiener explained:

> Messages are themselves a form of pattern and organization. Indeed it is possible to treat sets of messages as having an entropy like sets of states of the external world. Just as entropy is a measure of disorganization, the information carried by a set of messages is a measure of organization. In fact, it is possible to interpret the information carried by a message as essentially the negative of its entropy. . . . That is, the more probable the message, the less information it gives. (Wiener, 1954, p. 21)

The negative relationship between information and entropy presented Wiener with a challenge that Aristotle did not face, because Aristotle's biology and physics were fully consistent with his assumption of purpose and value in a human life. For Wiener, however, entropy appeared to be the "enemy" of information, organization and purpose. Thus, because of increasing entropy,

> it is highly probable that the whole universe around us will die the heat death, in which the world shall be reduced to one vast temperature equilibrium in which nothing really new ever happens. There will be nothing left but a drab uniformity. . . . (Wiener, 1954, p. 31)

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[3] For a detailed comparison of Aristotle and Wiener on animal behavior and human action, see Bynum, 2000.

[4] An extensive discussion of the relationship between Aristotle's science his account of human action and purpose can be found in Bynum, 1986.

How can there be purpose and value in a human life, if entropy is constantly increasing and thereby destroying anything of value?

Wiener's answer was that our tiny corner of the universe is *an enclave of decreasing entropy* brought about by living things and machines. The universe as a whole may be running down, but on earth (and possibly in other little corners of the universe) entropy is *decreasing* because of living things and machines. The final "heat-death" of the world is millions, perhaps billions, of years in the future; and humans have every reason to believe that their values and purposes will be important for a very long time to come:

> In a very real sense we are shipwrecked passengers on a doomed planet. Yet even in a shipwreck, human decencies and human values do not necessarily vanish. . . . [Thus] the theory of entropy, and the considerations of the ultimate heat death of the universe, need not have such profoundly depressing moral consequences as they seem to have at first glance. (Wiener, 1954, pp. 40-41)

From Human Purpose to Principles of Justice

Having established the continuing importance of human purpose and human values, Wiener was in position to derive an account of ethics and justice from his definition of human flourishing. To live a good life, as Wiener saw it, is to realize "the great human values which man possesses" through creative and flexible adaptation to the environment, made possible by sophisticated learning, reasoning and thinking. This is human information processing at its best — "the key to man's most noble flights". Of course, one person's achievements will differ from those of others, because humans have different levels of talent and potential. It is possible, therefore, to lead a good human life in a variety of ways — as a statesman, scholar, scientist, musician, artist, tradesman, farmer, and so on.

To enable human beings to reach their full potential and to live a good life, according to Wiener, society must uphold three "great principles of justice" and minimize the state's interference in human freedom. To highlight Wiener's "great principles of justice", let us refer to them as "The Principle of Freedom", "The Principle of Equality" and "The Principle of Benevolence". (Wiener himself did not assign names to them.) Using Wiener's own statement of these ethical principles produces the following set of definitions: (Wiener, 1954, pp. 105-106):

> *The Principle of Freedom* – Justice requires "the liberty of each human being to develop in his freedom the full measure of the human possibilities embodied in him".
>
> *The Principle of Equality* – Justice requires "the equality by which what is just for A and B remains just when the positions of A and B are interchanged".
>
> *The Principle of Benevolence* – Justice requires "a good will between man and man that knows no limits short of those of humanity itself".

Like Aristotle before him, Wiener viewed humans as fundamentally *social* beings that can reach their full potential only by active participation in a community. Society, therefore, is indispensable for a good human life. Society, however, also can be oppressive and despotic in ways that limit or even stifle individual freedom; so Wiener added a fourth principle, which could appropriately be called "The Principle of Minimum Infringement of Freedom" (Wiener himself did not give it a name.):

> *The Principle of Minimum Infringement of Freedom* — "What compulsion the very existence of the community and the state may demand must be exercised in such a way as to produce no unnecessary infringement of freedom". (Wiener, 1954, p.106)

Given Wiener's account of the purpose of a human life — to realize one's full human potential in variety and possibility of action — it is not surprising that the Principle of Freedom is first on his list. [His desire to minimize society's interference in personal freedom seems very similar to the "libertarian" attitude of later Internet "hackers" (in the positive sense of that term) who passionately argued for maximum freedom on "the electronic frontier" of cyberspace. (See, for example, Barlow, 1991.)] And since, for Wiener, the purpose of a human life is the same for everyone, the Principle of Equality follows nicely from his account of human nature. The third principle of justice expresses Wiener's belief that human freedom is best served when people sympathetically and helpfully look out for the wellbeing of all.

Wiener's Information Ethics Methodologies

Given his account of human flourishing and his principles of justice, Wiener was keen to ask questions about "what we do and how we should react to the new world that confronts us." (Wiener, 1954, p. 12). He employed several methods or strategies for analyzing, understanding, and dealing with social and ethical issues in the coming information age. His book *The Human Use of Human Beings* (especially the 1954 Doubleday Anchor Second Edition Revised) is the richest source of examples, though many passages in that book are disappointingly sketchy — even if inspiring and suggestive. Often, Wiener's discussions are casual and incomplete in exactly the places where we want him to be rigorous and thorough. For these reasons, we must examine what he *does* as well as what he *says* in order to understand his methodology. Wiener used at least three strategies for dealing with topics in information ethics. These include:

1. Exploring or envisioning the impacts of information technology upon fundamental human values with an eye toward advancing and defending those values.

2. Identifying ethical problems generated by information technology, and then suggesting ways to resolve those problems.

3. Proactively seeking ways to use information technology to create a better world.

Let us consider each of these strategies, one at a time, examining some examples from Wiener's writings, and then briefly discussing ways in which later thinkers employed similar methods.

Exploring the Impact of Information Technology on Human Values — It is already clear from what has been said above that Wiener regularly discussed ways to *defend* human values from damaging uses of information technology, as well as ways to *advance* human values with beneficial uses of such technology. He had much to say, for example, about the impacts of information technology on human *happiness* and *survival*. Thus, in Chapter X of *The Human Use of Human Beings*, he warned about grave harm to *human security* that could result if game-playing computers are used to set military strategy. And in Chapter III, he examined the central role of information feedback mechanisms in *learning*, both in humans and in machines.

In that same book, Wiener described communications within a society as "the cement which binds its fabric together" (p. 27), and he noted the crucial importance of open communications in a *democracy*, where "blocks to communication among individuals and classes are not too great" and *freedom* is thereby strengthened. He pointed out that, in fascist and despotic societies, communication among individuals and groups is severely restricted and censored, and freedom is thereby diminished. He also expressed worries about the communication infrastructure of America in the 1950s, because growing costs and complexities of communication technology were weakening the democracy-enhancing benefits of such technology. A number of later scholars have discussed the impact of information technology on democracy, including for example Deborah Johnson in her article "Is the Global Information Infrastructure a Democratic Technology?" (Johnson, 1997).

During the five decades after Wiener founded information ethics, a variety of other thinkers have used the strategy of examining the effects of information technology on human values. For example, in 1991 a major scholarly conference, the National Conference on Computing and Human Values,[5] was explicitly organized around this approach. In a keynote address to the attendees of that conference, the following challenge was given:

> Too often, new technology develops with little attention to its impact upon human values. . . . Let us do better! In particular, let us do what we can in this era of "the computer revolution" to see that computer technology *advances* human values. True enough, we could argue endlessly over the meanings of terms like "privacy", "health", "security", "fairness" or "ownership". Philosophers do it all the time — and *ought* to. But people understand such values well enough to desire and even to treasure them. We do not need absolute clarity or unattainable unanimity before we do anything to advance them. (Bynum, 1991, p. 1)

The fruitfulness of the "human-values approach" to information ethics can be seen in several recent developments, including the emergence of a new field of research called "value-sensitive computer design". (Example articles include Friedman and Nissenbaum, 1996; Friedman, 1997; Johnson, 1997; and Introna and Nissenbaum, 2000.) The most sophisticated and carefully developed version of this approach, to date, is presented in Philip Brey's important article "Disclosive Computer Ethics" (Brey, 2000).

[5] Sponsored by the Research Center on Computing & Society at Southern Connecticut State University and funded by grants from the National Science Foundation of the USA.

Resolving Ethical Problems Generated by Information Technology — The second strategy or methodology that Wiener used for information ethics was to *identify or envision ethical problems that information technology has generated or is likely to generate in the future, and then suggest ways to eliminate or minimize those problems.* The clearest and most fully worked out example is Wiener's analysis of the ethical implications of computerized factories. (See especially Chapter IX of *The Human Use of Human Beings.*) In the early 1950s, Wiener predicted that the world would soon see the creation of "the automatic factory", with an "ultra-rapid computing machine" functioning like a "brain" to control the production processes and monitor the quality of the factory's output. The computer would be hooked up to "artificial sense organs", like thermometers and gauges, enabling it to keep track of environmental conditions in the factory, as well as the progress of production runs. There would also be hardware "effectors" which would "act on the outer world", functioning like the arms, legs and tools that human workers would have used on the assembly line. In the "automatic factory", therefore, computer-driven hardware would replace the muscles and sense organs of human blue-collar workers; while the reasoning and calculating components of the computer would replace "low-level judgments" and actions of white-collar employees such as accountants, clerical workers, and factory librarians. The end result, said Wiener, might be unscrupulous factory owners getting very rich at the expense of laid-off workers and society in general.

To forestall such disastrous consequences, Wiener suggested that union leaders, business managers, and public policy makers should plan ahead and develop ways to deal with these problems before they happen. Thus, in circumstances like this, said Wiener, "instead of decreasing the responsibility of planners and organizers, we shall greatly increase them, for we shall make it possible for them to do things which they would not have thought of doing before." (Wiener, 1959, p. 39) As a socially active thinker, Wiener himself met with union leaders, business managers and public policy makers to discuss new rules and laws that should be put in place to minimize possible harm from automatic factories.

A number of later scholars in information ethics have developed methodologies that are similar to this. For example, in the mid 1970s Walter Maner discovered, in his Medical Ethics classes at Old Dominion University, that ethical problems are often exacerbated of significantly altered when computers get involved. In response to this realization, Maner created a new university course, which he called "Computer Ethics". Students in that course were to identify ethical problems "created, aggravated, or transformed by computer technology" and then ethically analyze those problems with an eye to resolving or eliminating them. (See Maner, 1980 and Pecorino & Maner, 1985.)

The most influential and carefully developed methodology that is similar to Wiener's second strategy is that of James Moor in his classic article "What Is Computer Ethics?" (Moor, 1985). According to Moor, computer technology is so flexible and so "logically malleable" that it functions almost like a "universal tool". Because of this, computer technology enables us to do things which were never done before, and we then are faced with "policy vacuums" — *Should* we do the many new things that computer technology makes possible? To answer this question, said Moor, we must formulate "new policies for the ethical use of computer technology".

Today, the field of computer ethics is replete with cases that illustrate the usefulness of Moor's "policy vacuum" approach. The Internet, for example, makes it very easy for college students to "construct" their term papers with plagiarized materials downloaded from the World Wide Web. As a result, teachers, librarians, and school administrators must now scramble to fill many "policy vacuums" with new rules and practices to minimize plagiarism. Another example is "hard core" pornography that lurks just a click away on the family computer. Parents and law enforcement officials are faced with the challenge to quickly develop policies to protect children from "hard-core porn", even in the "sanctuary" of their own homes and playrooms.

Creating a Better World with Information Technology — Wiener's third information ethics methodology was *to proactively use information technology to create a better world.* He regularly noted in his writings that such technology can be used for *good* as well as for evil; and his Principle of Benevolence implies that people should advance the interests of others as well as themselves.

Wiener took his own advice and participated in a variety of projects to develop prostheses and other devices to solve medical problems. Some of his projects included, for example, machines to help patients overcome tremors, an "artificial lung" controlled by the patient's own central nervous system, and a "hearing glove" to enable persons who are deaf to "hear" spoken words by converting sounds into tactile sensations. In his discussion of such prostheses, Wiener raised some important ethical and philosophical questions:

> Render unto man the things which are man's and unto the computer the things which are the computer's. This would seem the intelligent policy to adopt when we employ men and computers together in common undertakings. . . . What we now need is an independent study of systems involving both human and mechanical elements. (Wiener, 1964, p. 75)

> Thus there is a new engineering of prostheses possible, and it will involve the construction of systems of a mixed nature, involving both human and mechanical parts. However, this type of engineering need not be confined to the replacement of parts that we have lost. There is a prosthesis of parts which we do not have and which we never have had. (Wiener, 1964, p. 76)

Wiener pointed out that the propeller of a ship functions much like prostheses for humans, that are similar to "artificial flukes" on the tail of a dolphin. And what is the automatic pilot of an airplane but a "nervous system" for a man/machine that can fly? Beings that consist of human and mechanical parts working together can be powerful agents capable of doing much good in the world— but also much evil, as well. These concerns about man/machine combinations, which Wiener raised in the 1950s and early 1960s, are similar in many ways to contemporary worries about "cybogs" and "cyborgs".

Wiener and the Internet

Norbert Wiener died in 1964, five years before the US government launched the ARPANET, — a military computer network that would evolve into the Internet by the mid-1970s. Wiener, therefore, did not live to see even the earliest stages of the Internet, not to mention today's globally extended World Wide Web. In spite of this, it is clear from his writings that he anticipated many of the ethical issues and philosophical questions associated with the Internet; and if he were to return to earth today, he would not be surprised to find it here. Indeed, by the mid-1950s, Wiener already assumed that communications technologies had effectively created a global information network:

> The invention of the telephone, the telegraph, and other similar means of communication have shown that this capacity [i.e., the ability to carry on conversations between individuals] is not intrinsically restricted to the immediate presence of the individual, for we have many means to carry this tool of communication to the ends of the earth. (Wiener, 1954, p.91, bracketed words added for clarification)

But Wiener envisioned a much more sophisticated network in the future— one which would include machines communicating with humans and with each other:

> It is the thesis of this book that society can only be understood through a study of the messages and the communication facilities which belong to it; and that in the future development of these messages and communication facilities, messages between man and machines, between machines and man, and between machine and machine, are destined to play an ever-increasing part. (Wiener, 1954, p. 16)

Wiener also noted that the ability to send and receive messages over networks empowers a person to act at a distance and, in a sense, "be everywhere":

> Where a man's word goes, and where his power of perception goes, to that point his control and in a sense his physical existence is extended. To see and to give commands to the whole world is almost the same as being everywhere. . . . Even now the transportation of messages serves to forward an extension of man's senses and his capabilities of action from one end of the world to another. (Wiener, 1954, pp. 97-98)

To illustrate this point, Wiener described an imaginary case in which an architect in Europe supervises the construction of a building in the United States without ever leaving Europe by sending and receiving plans, photos and instructions over telephone lines using an early version of the FAX machine.

Wiener's vision of "the automatic age", then, included the possibility of a communications network with humans and machines interacting — a network that bestows the power of action "from one end of the world to another" — a network that enables one to "be everywhere". Given this vision of the future, plus Wiener's view that communications constitute the "cement" which binds society together, it is an easy step to speculate about the possibility of a future world community or a world government. Indeed, even without a powerful global network like the Internet to pique his imagination, Wiener made comments like this:

> With the airplane and the radio the word of the rulers extends to the ends of the earth, and very many of the factors which previously precluded a World State have been abrogated. It is even possible to maintain that modern communication, which forces us to adjudicate the international claims of different broadcasting systems and different airplane nets, has made the World State inevitable. (Wiener, 1954, p. 92)

Information ethics scholars who came after Wiener also speculated about world government; and others have explored less comprehensive global consequences like the possible emergence of a "global ethics". For example, in her article, "The Computer Revolution and the Problem of Global Ethics", Krystyna Gorniak-Kocikowska (Gorniak, 1996) predicted that the computer revolution will lead to the emergence of a new world-wide ethics that will supercede "local" ethical theories, like Europe's Benthamite and Kantian systems and ethical systems in other regions of the world; and Charles Ess, in his "Cultures in Collision: Philosophical Lessons from Computer-Mediated Communication" (Ess, 2002) envisions a "genuinely *global* ethics", which nevertheless respects and encourages a rich diversity of cultures and values.

Ethics and Non-Human Agents

Wiener's predictions about the coming "automatic age" included his view that there will be many machines with "brains of brass and thews of iron" — machines that will learn and reason and make decisions on their own. Such predictions were very controversial at the time, and many people simply did not believe him. Wiener offered examples of decision-making machines that already existed, including (1) a checkers-playing machine that quickly learned from its "experiences" and then regularly defeated the man who made it, (2) a chess-playing machine that could play chess at the level of an amateur, and (3) a war-games machine used by the US government to teach military planning and tactics. Such machines, he explained, can learn in two different senses:

1. They can record information from their past activities, and then use this information to adjust their future activities.

2. They can save information about how successfully their programming guided their behavior, then use this information to *re-program* themselves to alter their future behavior.

Wiener believed that it was at least theoretically possible for machines to someday duplicate the intellectual abilities of a human being:

> Theoretically, if we could build a machine whose mechanical structure duplicated human physiology, then we could have a machine whose intellectual capacities would duplicate those of human beings. (Wiener, 1954, p. 57)

Wiener was skeptical, however, that we would ever succeed in building such a machine, because he thought the requisite parts of a mechanical brain would be too numerous and too big to duplicate the functions of billions of neurons in a human being. Though he was skeptical of this possibility, he was unwilling to completely rule it out. (See Wiener, 1954, p. 159 and Wiener, 1959, pp. 36-41.) He *did* rule out, however, the idea that a human should ever *trust* machines to make critical decisions in place of human beings:

> [A person should] not leap in where angels fear to tread, unless he is prepared to accept the punishment of the fallen angels. Neither will he calmly transfer to the machine made in his own image the responsibility for his choice of good and evil, without continuing to accept a full responsibility for that choice. (Wiener, 1954, p. 184)

For decision-making machines, we seem to need something like a code of ethics than can be programmed into them:

> Any machine constructed for the purpose of making decisions, if it does not possess the power of learning, will be completely literal-minded. Woe to us if we let it decide our conduct, unless we have previously examined the laws of its action, and know fully that its conduct will be carried out on principles acceptable to us! (Wiener, 1954, p. 185)

But if our machine can *learn*, it might alter the code of ethics that we placed into it when we built it:

> On the other hand, the machine . . . which can learn and can make decisions on the basis of its learning, will in no way be obliged to make such decisions as we should have made, or will be acceptable to us. For the man who is not aware of this, to throw the problem of his responsibility on the machine, whether it can learn or not, is to cast his responsibility to the winds, and to find it coming back seated on the whirlwind. (Wiener, 1954, p. 185)

In recent years, decades after Wiener first raised such troubling issues, information ethics scholars have been hard at work trying to cope with them. [See, for example, Eichmann's seminal article, "Ethical Web Agents" (Eichmann, 1994) and Floridi & Sanders, "On the Morality of Artificial Agents" (Floridi & Sanders, 2001b).]

Concluding Remarks: Wiener's Legacy

Norbert Wiener was a great scientist who helped to create "the information age". In addition, he was also one of those very rare scientists who could see the social and ethical importance of his own great achievements and those of his fellow scientists. The philosophical foundation that Wiener laid for the field of information ethics is deep and profound, and it remains a valuable resource for research and for practical action.

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