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A Technology of Behavior

IN TRYING TO SOLVE the terrifying problems that face us in the world today, we naturally turn to the things we do best. We play from strength, and our strength is science and technology. To contain a population explosion we look for better methods of birth control. Threatened by a nuclear holocaust, we build bigger deterrent forces and anti-ballistic-missile systems. We try to stave off world famine with new foods and better ways of growing them. Improved sanitation and medicine will, we hope, control disease, better housing and transportation will solve the problems of the ghettos, and new ways of reducing or disposing of waste will stop the pollution of the environment. We can point to remarkable achievements in all these fields, and it is not surprising that we should try to extend them. But things grow steadily worse and it is disheartening to find that technology itself is increasingly at fault. Sanitation and medicine have made the problems of population more acute, war has acquired a new horror with the invention of nuclear weapons, and the affluent pursuit of happiness is largely responsible for pollution. As Darlington* has said, "Every new source from which man has increased his power on the earth has been used to diminish the prospects of his successors. All his progress has been made at the

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expense of damage to his environment which he cannot repair and could not foresee."

Whether or not he could have foreseen the damage, man must repair it or all is lost. And he can do so if he will recognize the nature of the difficulty. The application of the physical and biological sciences alone will not solve our problems because the solutions lie in another field. Better contraceptives will control population only if people use them. New weapons may offset new defenses and vice versa, but a nuclear holocaust can be prevented only if the conditions under which nations make war can be changed. New methods of agriculture and medicine will not help if they are not practiced, and housing is a matter not only of buildings and cities but of how people live. Overcrowding can be corrected only by inducing people not to crowd, and the environment will continue to deteriorate until polluting practices are abandoned.

In short, we need to make vast changes in human behavior, and we cannot make them with the help of nothing more than physics or biology, no matter how hard we try. (And there are other problems, such as the breakdown of our educational system and the disaffection and revolt of the young, to which physical and biological technologies are so obviously irrelevant that they have never been applied.) It is not enough to "use technology with a deeper understanding of human issues," or to "dedicate technology to man's spiritual needs," or to "encourage technologists to look at human problems." Such expressions imply that where human behavior begins, technology stops, and that we must carry on, as we have in the past, with what we have learned from personal experience or from those collections of personal experiences called history, or with the distillations of experience to be found in folk wisdom and practical rules of thumb. These have been

available for centuries, and all we have to show for them is the state of the world today.

What we need is a technology of behavior. We could solve our problems quickly enough if we could adjust the growth of the world's population as precisely as we adjust the course of a spaceship, or improve agriculture and industry with some of the confidence with which we accelerate high-energy particles, or move toward a peaceful world with something like the steady progress with which physics has approached absolute zero (even though both remain presumably out of reach). But a behavioral technology comparable in power and precision to physical and biological technology is lacking, and those who do not find the very possibility ridiculous are more likely to be frightened by it than reassured. That is how far we are from "understanding human issues" in the sense in which physics and biology understand their fields, and how far we are from preventing the catastrophe toward which the world seems to be inexorably moving.

Twenty-five hundred years ago it might have been said that man understood himself as well as any other part of his world. Today he is the thing he understands least. Physics and biology have come a long way, but there has been no comparable development of anything like a science of human behavior. Greek physics and biology are now of historical interest only (no modern physicist or biologist would turn to Aristotle for help), but the dialogues of Plato are still assigned to students and cited as if they threw light on human behavior. Aristotle could not have understood a page of modern physics or biology, but Socrates and his friends would have little trouble in following most current discussions of human affairs. And as to technology, we have made immense strides in controlling

the physical and biological worlds, but our practices in government, education, and much of economics, though adapted to very different conditions, have not greatly improved.

We can scarcely explain this by saying that the Greeks knew all there was to know about human behavior. Certainly they knew more than they knew about the physical world, but it was still not much. Moreover, their way of thinking about human behavior must have had some fatal flaw. Whereas Greek physics and biology, no matter how crude, led eventually to modern science, Greek theories of human behavior led nowhere. If they are with us today, it is not because they possessed some kind of eternal verity, but because they did not contain the seeds of anything better.

It can always be argued that human behavior is a particularly difficult field. It is, and we are especially likely to think so just because we are so inept in dealing with it. But modern physics and biology successfully treat subjects that are certainly no simpler than many aspects of human behavior. The difference is that the instruments and methods they use are of commensurate complexity. The fact that equally powerful instruments and methods are not available in the field of human behavior is not an explanation; it is only part of the puzzle. Was putting a man on the moon actually easier than improving education in our public schools? Or than constructing better kinds of living space for everyone? Or than making it possible for everyone to be gainfully employed and, as a result, to enjoy a higher standard of living? The choice was not a matter of priorities, for no one could have said that it was more important to get to the moon. The exciting thing about getting to the moon was its feasibility. Science and technology had reached the point at which, with one great push, the thing could be done. There is no

comparable excitement about the problems posed by human behavior. We are not close to solutions.

It is easy to conclude that there must be something about human behavior which makes a scientific analysis, and hence an effective technology, impossible, but we have not by any means exhausted the possibilities. There is a sense in which it can be said that the methods of science have scarcely yet been applied to human behavior. We have used the instruments of science; we have counted and measured and compared; but something essential to scientific practice is missing in almost all current discussions of human behavior. It has to do with our treatment of the causes of behavior. (The term "cause" is no longer common in sophisticated scientific writing, but it will serve well enough here.)

Man's first experience with causes probably came from his own behavior: things moved because he moved them. If other things moved, it was because someone else was moving them, and if the mover could not be seen, it was because he was invisible. The Greek gods served in this way as the causes of physical phenomena. They were usually outside the things they moved, but they might enter into and "possess" them. Physics and biology soon abandoned explanations of this sort and turned to more useful kinds of causes, but the step has not been decisively taken in the field of human behavior. Intelligent people no longer believe that men are possessed by demons (although the exorcism of devils is occasionally practiced, and the daimonic has reappeared in the writings of psychotherapists), but human behavior is still commonly attributed to indwelling agents. A juvenile delinquent is said, for example, to be suffering from a disturbed personality. There would be no point in saying it if the personality were not somehow distinct from the body which has

got itself into trouble. The distinction is clear when one body is said to contain several personalities which control it in different ways at different times. Psychoanalysts have identified three of these personalities—the ego, superego, and id—and interactions among them are said to be responsible for the behavior of the man in whom they dwell.

Although physics soon stopped personifying things in this way, it continued for a long time to speak as if they had wills, impulses, feelings, purposes, and other fragmentary attributes of an indwelling agent. According to Butterfield, Aristotle argued that a falling body accelerated because it grew more jubilant as it found itself nearer home, and later authorities supposed that a projectile was carried forward by an impetus, sometimes called an "impetuosity." All this was eventually abandoned, and to good effect, but the behavioral sciences still appeal to comparable internal states. No one is surprised to hear it said that a person carrying good news walks more rapidly because he feels jubilant, or acts carelessly because of his impetuosity, or holds stubbornly to a course of action through sheer force of will. Careless references to purpose are still to be found in both physics and biology, but good practice has no place for them; yet almost everyone attributes human behavior to intentions, purposes, aims, and goals. If it is still possible to ask whether a machine can show purpose, the question implies, significantly, that if it can it will more closely resemble a man.

Physics and biology moved farther away from personified causes when they began to attribute the behavior of things to essences, qualities, or natures. To the medieval alchemist, for example, some of the properties of a substance might be due to the mercurial essence, and substances were compared in what might have been called a "chemistry of individual differences." Newton complained of the practice in his contemporaries: "To tell us that every species of thing is endowed with an occult specific quality by which it acts and produces manifest effects is to tell us nothing." (Occult qualities were examples of the hypotheses Newton rejected when he said "Hypotheses non fingo," though he was not quite as good as his word.) Biology continued for a long time to appeal to the *nature* of living things, and it did not wholly abandon vital forces until the twentieth century. Behavior, however, is still attributed to human nature, and there is an extensive "psychology of individual differences" in which people are compared and described in terms of traits of character, capacities, and abilities.

Almost everyone who is concerned with human affairs—as political scientist, philosopher, man of letters, economist, psychologist, linguist, sociologist, theologian, anthropologist, educator, or psychotherapist—continues to talk about human behavior in this prescientific way. Every issue of a daily paper, every magazine, every professional journal, every book with any bearing whatsoever on human behavior will supply examples. We are told that to control the number of people in the world we need to change *attitudes* toward children, overcome *pride* in size of family or in sexual potency, build some *sense of responsibilty* toward offspring, and reduce the role played by a large family in allaying *concern* for old age. To work for peace we must deal with the *will to power* or the *paranoid delusions* of leaders; we must remember that wars begin in the *minds* of men, that there is something suicidal in man—a *death instinct* perhaps—which leads to war, and that man is aggressive by *nature*. To solve the problems of the poor we must inspire *self-respect*, encourage *initiative*, and reduce *frustration*. To allay the disaffection of the young we must provide a *sense*

of purpose and reduce feelings of *alienation* or *hopelessness.* Realizing that we have no effective means of doing any of this, we ourselves may experience *a crisis of belief* or a *loss of confidence,* which can be corrected only by returning to a *faith in man's inner capacities.* This is staple fare. Almost no one questions it. Yet there is nothing like it in modern physics or most of biology, and that fact may well explain why a science and a technology of behavior have been so long delayed.

It is usually supposed that the "behavioristic" objection to ideas, feelings, traits of character, will, and so on concerns the stuff of which they are said to be made. Certain stubborn questions about the nature of mind have, of course, been debated for more than twenty-five hundred years and still go unanswered. How, for example, can the mind move the body? As late as 1965 Karl Popper could put the question this way: "What we want is to understand how such nonphysical things as *purposes, deliberations, plans, decisions, theories, tensions,* and *values* can play a part in bringing about physical changes in the physical world." And, of course, we also want to know where these nonphysical things come from. To that question the Greeks had a simple answer: from the gods. As Dodds has pointed out, the Greeks believed that if a man behaved foolishly, it was because a hostile god had planted ατη (infatuation) in his breast. A friendly god might give a warrior an extra amount of μενος, with the help of which he would fight brilliantly. Aristotle thought there was something divine in thought, and Zeno held that the intellect *was* God.

We cannot take that line today, and the commonest alternative is to appeal to antecedent physical events. A person's genetic endowment, a product of the evolution of the species, is said to explain part of the workings of his mind and his personal history the rest. For example, because of (physical) competition during the course of evolution people now have (nonphysical) feelings of aggression which lead to (physical) acts of hostility. Or, the (physical) punishment a small child receives when he engages in sex play produces (nonphysical) feelings of anxiety which interfere with his (physical) sexual behavior as an adult. The nonphysical stage obviously bridges long periods of time: aggression reaches back into millions of years of evolutionary history, and anxiety acquired when one is a child survives into old age.

The problem of getting from one kind of stuff to another could be avoided if everything were either mental or physical, and both these possibilities have been considered. Some philosophers have tried to stay within the world of the mind, arguing that only immediate experience is real, and experimental psychology began as an attempt to discover the mental laws which governed interactions among mental elements. Contemporary "intrapsychic" theories of psychotherapy tell us how one feeling leads to another (how frustration breeds aggression, for example), how feelings interact, and how feelings which have been put out of mind fight their way back in. The complementary line that the mental stage is really physical was taken, curiously enough, by Freud, who believed that physiology would eventually explain the workings of the mental apparatus. In a similar vein, many physiological psychologists continue to talk freely about states of mind, feelings, and so on, in the belief that it is only a matter of time before we shall understand their physical nature.

The dimensions of the world of mind and the transition from one world to another do raise embarrassing

problems, but it is usually possible to ignore them, and this may be good strategy, for the important objection to mentalism is of a very different sort. The world of the mind steals the show. Behavior is not recognized as a subject in its own right. In psychotherapy, for example, the disturbing things a person does or says are almost always regarded merely as symptoms, and compared with the fascinating dramas which are staged in the depths of the mind, behavior itself seems superficial indeed. In linguistics and literary criticism what a man says is almost always treated as the expression of ideas or feelings. In political science, theology, and economics, behavior is usually regarded as the material from which one infers attitudes, intentions, needs, and so on. For more than twenty-five hundred years close attention has been paid to mental life, but only recently has any effort been made to study human behavior as something more than a mere by-product.

The conditions of which behavior is a function are also neglected. The mental explanation brings curiosity to an end. We see the effect in casual discourse. If we ask someone, "Why did you go to the theater?" and he says, "Because I felt like going," we are apt to take his reply as a kind of explanation. It would be much more to the point to know what has happened when he has gone to the theater in the past, what he heard or read about the play he went to see, and what other things in his past or present environments might have induced him to go (as opposed to doing something else), but we accept "I felt like going" as a sort of summary of all this and are not likely to ask for details.

The professional psychologist often stops at the same point. A long time ago William James corrected a prevailing view of the relation between feelings and action by asserting, for example, that we do not run away because we are afraid but are afraid because we run

away. In other words, what we feel when we feel afraid is our behavior—the very behavior which in the traditional view expresses the feeling and is explained by it. But how many of those who have considered James's argument have noted that no antecedent event has in fact been pointed out? Neither "because" should be taken seriously. No explanation has been given as to why we run away *and* feel afraid.

Whether we regard ourselves as explaining feelings or the behavior said to be caused by feelings, we give very little attention to antecedent circumstances. The psychotherapist learns about the early life of his patient almost exclusively from the patient's memories, which are known to be unreliable, and he may even argue that what is important is not what actually happened but what the patient remembers. In the psychoanalytic literature there must be at least a hundred references to felt anxiety for every reference to a punishing episode to which anxiety might be traced. We even seem to prefer antecedent histories which are clearly out of reach. There is a good deal of current interest, for example, in what must have happened during the evolution of the species to explain human behavior, and we seem to speak with special confidence just because what actually happened can only be inferred.

Unable to understand how or why the person we see behaves as he does, we attribute his behavior to a person we cannot see, whose behavior we cannot explain either but about whom we are not inclined to ask questions. We probably adopt this strategy not so much because of any lack of interest or power but because of a longstanding conviction that for much of human behavior there *are* no relevant antecedents. The function of the inner man is to provide an explanation which will not be explained in turn. Explanation stops with him. He is not a mediator between past history

and current behavior, he is a *center* from which behavior emanates. He initiates, originates, and creates, and in doing so he remains, as he was for the Greeks, divine. We say that he is autonomous—and, so far as a science of behavior is concerned, that means miraculous.

The position is, of course, vulnerable. Autonomous man serves to explain only the things we are not yet able to explain in other ways. His existence depends upon our ignorance, and he naturally loses status as we come to know more about behavior. The task of a scientific analysis is to explain how the behavior of a person as a physical system is related to the conditions under which the human species evolved and the conditions under which the individual lives. Unless there is indeed some capricious or creative intervention, these events must be related, and no intervention is in fact needed. The contingencies of survival responsible for man's genetic endowment would produce tendencies to *act* aggressively, not feelings of aggression. The punishment of sexual behavior changes sexual *behavior*, and any feelings which may arise are at best by-products. Our age is not suffering from anxiety but from the accidents, crimes, wars, and other dangerous and painful things to which people are so often exposed. Young people drop out of school, refuse to get jobs, and associate only with others of their own age not because they feel alienated but because of defective social environments in homes, schools, factories, and elsewhere.

We can follow the path taken by physics and biology by turning directly to the relation between behavior and the environment and neglecting supposed mediating states of mind. Physics did not advance by looking more closely at the jubilance of a falling body, or biology by looking at the nature of vital spirits, and we do not need to try to discover what personalities,

states of mind, feelings, traits of character, plans, purposes, intentions, or the other perquisites of autonomous man really are in order to get on with a scientific analysis of behavior.

There are reasons why it has taken us so long to reach this point. The things studied by physics and biology do not behave very much like people, and it eventually seems rather ridiculous to speak of the jubilance of a falling body or the impetuosity of a projectile; but people do behave like people, and the outer man whose behavior is to be explained could be very much like the inner man whose behavior is said to explain it. The inner man has been created in the image of the outer.

A more important reason is that the inner man seems at times to be directly observed. We must infer the jubilance of a falling body, but can we not *feel* our own jubilance? We do, indeed, feel things inside our own skin, but we do not feel the things which have been invented to explain behavior. The possessed man does not feel the possessing *demon* and may even deny that one exists. The juvenile delinquent does not feel his *disturbed personality*. The intelligent man does not feel his *intelligence* or the introvert his *introversion*. (In fact, these dimensions of mind or character are said to be observable only through complex statistical procedures.) The speaker does not feel the *grammatical* rules he is said to apply in composing sentences, and men spoke grammatically for thousands of years before anyone knew there were rules. The respondent to a questionnaire does not feel the *attitudes* or *opinions* which lead him to check items in particular ways. We do feel certain states of our bodies associated with behavior, but as Freud pointed out, we behave in the

same way when we do not feel them; they are by-products and not to be mistaken for causes.

There is a much more important reason why we have been so slow in discarding mentalistic explanations: it has been hard to find alternatives. Presumably we must look for them in the external environment, but the role of the environment is by no means clear. The history of the theory of evolution illustrates the problem. Before the nineteenth century, the environment was thought of simply as a passive setting in which many different kinds of organisms were born, reproduced themselves, and died. No one saw that the environment was responsible for the fact that there *were* many different kinds (and that fact, significantly enough, was attributed to a creative Mind). The trouble was that the environment acts in an inconspicuous way: it does not push or pull, it *selects*. For thousands of years in the history of human thought the process of natural selection went unseen in spite of its extraordinary importance. When it was eventually discovered, it became, of course, the key to evolutionary theory.

The effect of the environment on behavior remained obscure for an even longer time. We can see what organisms do to the world around them, as they take from it what they need and ward off its dangers, but it is much harder to see what the world does to them. It was Descartes who first suggested that the environment might play an active role in the determination of behavior, and he was apparently able to do so only because he was given a strong hint. He knew about certain automata in the Royal Gardens of France which were operated hydraulically by concealed valves. As Descartes described it, people entering the gardens "necessarily tread on certain tiles

or plates, which are so disposed that if they approach a bathing Diana, they cause her to hide in the rosebushes, and if they try to follow her, they cause a Neptune to come forward to meet them, threatening them with his trident." The figures were entertaining just because they behaved like people, and it appeared, therefore, that something very much like human behavior could be explained mechanically. Descartes took the hint: living organisms might move for similar reasons. (He excluded the human organism, presumably to avoid religious controversy.)

The triggering action of the environment came to be called a "stimulus"—the Latin for goad—and the effect on an organism a "response," and together they were said to compose a "reflex." Reflexes were first demonstrated in small decapitated animals, such as salamanders, and it is significant that the principle was challenged throughout the nineteenth century because it seemed to deny the existence of an autonomous agent—the "soul of the spinal cord"—to which movement of a decapitated body had been attributed. When Pavlov showed how new reflexes could be built up through conditioning, a full-fledged stimulus-response psychology was born, in which all behavior was regarded as reactions to stimuli. One writer put it this way: "We are prodded or lashed through life." The stimulus-response model was never very convincing, however, and it did not solve the basic problem, because something like an inner man had to be invented to convert a stimulus into a response. Information theory ran into the same problem when an inner "processer" had to be invented to convert input into output.

The effect of an eliciting stimulus is relatively easy to see, and it is not surprising that Descartes' hypothesis held a dominant position in behavior theory for a long time, but it was a false scent from which a

scientific analysis is only now recovering. The environment not only prods or lashes, it *selects*. Its role is similar to that in natural selection, though on a very different time scale, and was overlooked for the same reason. It is now clear that we must take into account what the environment does to an organism not only before but after it responds. Behavior is shaped and maintained by its consequences. Once this fact is recognized, we can formulate the interaction between organism and environment in a much more comprehensive way.

There are two important results. One concerns the basic analysis. Behavior which operates upon the environment to produce consequences ("operant" behavior) can be studied by arranging environments in which specific consequences are contingent upon it. The contingencies under investigation have become steadily more complex, and one by one they are taking over the explanatory functions previously assigned to personalities, states of mind, feelings, traits of character, purposes, and intentions. The second result is practical: the environment can be manipulated. It is true that man's genetic endowment can be changed only very slowly, but changes in the environment of the individual have quick and dramatic effects. A technology of operant behavior is, as we shall see, already well advanced, and it may prove to be commensurate with our problems.

That possibility raises another problem, however, which must be solved if we are to take advantage of our gains. We have moved forward by dispossessing autonomous man, but he has not departed gracefully. He is conducting a sort of rear-guard action in which, unfortunately, he can marshal formidable support. He is still an important figure in political science, law, religion, economics, anthropology, sociology, psychotherapy, philosophy, ethics, history, education, child care, linguistics, architecture, city planning, and family life. These fields have their specialists, and every specialist has a theory, and in almost every theory the autonomy of the individual is unquestioned. The inner man is not seriously threatened by data obtained through casual observation or from studies of the structure of behavior, and many of these fields deal only with groups of people, where statistical or actuarial data impose few restraints upon the individual. The result is a tremendous weight of traditional "knowledge," which must be corrected or displaced by a scientific analysis.

Two features of autonomous man are particularly troublesome. In the traditional view, a person is free. He is autonomous in the sense that his behavior is uncaused. He can therefore be held responsible for what he does and justly punished if he offends. That view, together with its associated practices, must be re-examined when a scientific analysis reveals unsuspected controlling relations between behavior and environment. A certain amount of external control can be tolerated. Theologians have accepted the fact that man must be predestined to do what an omniscient God knows he will do, and the Greek dramatist took inexorable fate as his favorite theme. Soothsayers and astrologers often claim to predict what men will do, and they have always been in demand. Biographers and historians have searched for "influences" in the lives of individuals and peoples. Folk wisdom and the insights of essayists like Montaigne and Bacon imply some kind of predictability in human conduct, and the statistical and actuarial evidences of the social sciences point in the same direction.

Autonomous man survives in the face of all this be-

cause he is the happy exception. Theologians have reconciled predestination with free will, and the Greek audience, moved by the portrayal of an inescapable destiny, walked out of the theater free men. The course of history has been turned by the death of a leader or a storm at sea, as a life has been changed by a teacher or a love affair, but these things do not happen to everyone, and they do not affect everyone in the same way. Some historians have made a virtue of the unpredictability of history. Actuarial evidence is easily ignored; we read that hundreds of people will be killed in traffic accidents on a holiday weekend and take to the road as if personally exempt. Very little behavioral science raises "the specter of predictable man." On the contrary, many anthropologists, sociologists, and psychologists have used their expert knowledge to prove that man is free, purposeful, and responsible. Freud was a determinist—on faith, if not on the evidence—but many Freudians have no hesitation in assuring their patients that they are free to choose among different courses of action and are in the long run the architects of their own destinies.

This escape route is slowly closed as new evidences of the predictability of human behavior are discovered. Personal exemption from a complete determinism is revoked as a scientific analysis progresses, particularly in accounting for the behavior of the individual. Joseph Wood Krutch has acknowledged the actuarial facts while insisting on personal freedom: "We can predict with a considerable degree of accuracy how many people will go to the seashore on a day when the temperature reaches a certain point, even how many will jump off a bridge . . . although I am not, nor are you, compelled to do either." But he can scarcely mean that those who go to the seashore do not go for good reason, or that circumstances in the

life of a suicide do not have some bearing on the fact that he jumps off a bridge. The distinction is tenable only so long as a word like "compel" suggests a particularly conspicuous and forcible mode of control. A scientific analysis naturally moves in the direction of clarifying all kinds of controlling relations.

By questioning the control exercised by autonomous man and demonstrating the control exercised by the environment, a science of behavior also seems to question dignity or worth. A person is responsible for his behavior, not only in the sense that he may be justly blamed or punished when he behaves badly, but also in the sense that he is to be given credit and admired for his achievements. A scientific analysis shifts the credit as well as the blame to the environment, and traditional practices can then no longer be justified. These are sweeping changes, and those who are committed to traditional theories and practices naturally resist them.

There is a third source of trouble. As the emphasis shifts to the environment, the individual seems to be exposed to a new kind of danger. Who is to construct the controlling environment and to what end? Autonomous man presumably controls himself in accordance with a built-in set of values; he works for what he finds good. But what will the putative controller find good, and will it be good for those he controls? Answers to questions of this sort are said, of course, to call for value judgments.

Freedom, dignity, and value are major issues, and unfortunately they become more crucial as the power of a technology of behavior becomes more nearly commensurate with the problems to be solved. The very change which has brought some hope of a solution is responsible for a growing opposition to the kind of solution proposed. This conflict is itself a problem in

human behavior and may be approached as such. A science of behavior is by no means as far advanced as physics or biology, but it has an advantage in that it may throw some light on its own difficulties. Science *is* human behavior, and so is the opposition to science. What has happened in man's struggle for freedom and dignity, and what problems arise when scientific knowledge begins to be relevant in that struggle? Answers to these questions may help to clear the way for the technology we so badly need.

In what follows, these issues are discussed "from a scientific point of view," but this does not mean that the reader will need to know the details of a scientific analysis of behavior. A mere interpretation will suffice. The nature of such an interpretation is, however, easily misunderstood. We often talk about things we cannot observe or measure with the precision demanded by a scientific analysis, and in doing so there is much to be gained from using terms and principles which have been worked out under more precise conditions. The sea at dusk glows with a strange light, frost forms on the windowpane in an unusual pattern, and the soup fails to thicken on the stove, and specialists tell us why. We can, of course, challenge them: they do not have "the facts," and what they say cannot be "proved," but they are nevertheless more likely to be right than those who lack an experimental background, and they alone can tell us how to move on to a more precise study if it seems worthwhile.

An experimental analysis of behavior offers similar advantages. When we have observed behavioral processes under controlled conditions, we can more easily spot them in the world at large. We can identify significant features of behavior and of the environment and are therefore able to neglect insignificant ones,

no matter how fascinating they may be. We can reject traditional explanations if they have been tried and found wanting in an experimental analysis and then press forward in our inquiry with unallayed curiosity. The instances of behavior cited in what follows are not offered as "proof" of the interpretation. The proof is to be found in the basic analysis. The principles used in interpreting the instances have a plausibility which would be lacking in principles drawn entirely from casual observation.

The text will often seem inconsistent. English, like all languages, is full of prescientific terms which usually suffice for purposes of casual discourse. No one looks askance at the astronomer when he says that the sun rises or that the stars come out at night, for it would be ridiculous to insist that he should always say that the sun appears over the horizon as the earth turns or that the stars become visible as the atmosphere ceases to refract sunlight. All we ask is that he can give a more precise translation if one is needed. The English language contains many more expressions referring to human behavior than to other aspects of the world, and technical alternatives are much less familiar. The use of casual expressions is therefore much more likely to be challenged. It may seem inconsistent to ask the reader to "keep a point in mind" when he has been told that mind is an explanatory fiction, or to "consider the idea of freedom" if an idea is simply an imagined precursor of behavior, or to speak of "reassuring those who fear a science of behavior" when all that is meant is changing their behavior with respect to such a science. The book could have been written for a technical reader without expressions of that sort, but the issues are important to the nonspecialist and need to be discussed in a nontechnical fashion. No doubt many of the mentalistic

expressions imbedded in the English language cannot be as rigorously translated as "sunrise," but acceptable translations are not out of reach.

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Almost all our major problems involve human behavior, and they cannot be solved by physical and biological technology alone. What is needed is a technology of behavior, but we have been slow to develop the science from which such a technology might be drawn. One difficulty is that almost all of what is called behavioral science continues to trace behavior to states of mind, feelings, traits of character, human nature, and so on. Physics and biology once followed similar practices and advanced only when they discarded them. The behavioral sciences have been slow to change partly because the explanatory entities often seem to be directly observed and partly because other kinds of explanations have been hard to find. The environment is obviously important, but its role has remained obscure. It does not push or pull, it *selects,* and this function is difficult to discover and analyze. The role of natural selection in evolution was formulated only a little more than a hundred years ago, and the selective role of the environment in shaping and maintaining the behavior of the individual is only beginning to be recognized and studied. As the interaction between organism and environment has come to be understood, however, effects once assigned to states of mind, feelings, and traits are beginning to be traced to accessible conditions, and a technology of behavior may therefore become available. It will not solve our problems, however, until it replaces traditional prescientific views, and these are strongly entrenched. Freedom and dignity illustrate the difficulty. They are the possessions of the autonomous man of

traditional theory, and they are essential to practices in which a person is held responsible for his conduct and given credit for his achievements. A scientific analysis shifts both the responsibility and the achievement to the environment. It also raises questions concerning "values." Who will use a technology and to what ends? Until these issues are resolved, a technology of behavior will continue to be rejected, and with it possibly the only way to solve our problems.