TECHNOLOGY AND THE METAMORPHOSIS OF HUMANITY

Edited by

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This e-book is an edited version of my contributions on this topic that appeared originally in the co-edited volume Technology and Human Affairs (The C. V. Mosby Company, 1981).

PREFACE

After decades of writing legal articles, I feel the urge to retrieve my previous academic life in Philosophy, especially in the areas of logic, ethics and technology. My interest in technology was reignited recently by the widespread national conversation about the pandemic and the implications of the introduction of a new generation of vaccines, namely ones that use mRNA technology.

As a result, I decided to dust off a collection of articles about technology in various fields that I published previously and used as a textbook for my classes on the philosophy of technology at Texas A&M University. While this collection is now decades old, it nevertheless includes important insights, whether theoretical or practical. I am hoping that the reader can use them as a stepping stone into further discussion about today's challenges. It is my opinion that a historical depth to one's thought enriches it.

I would like to thank my colleague Professor Fabrizio Conti, at John Cabot University, Rome, Italy, for encouraging me in this new direction, and inviting me to virtually attend a most fascinating lecture entitled "Leibnitz' Teleology or a Prehistory of Cybernetics" by Professor Brunella Antomarini. This insightful lecture opened for me new avenues of thinking that I hope to address after completing my pending manuscripts in law.

I would like also to thank all those who helped me over the years in advancing my thinking and interest in this area, including Professor Larry Hickman who enthusiastically introduced me to this field and co-edited with me a volume on the topic. This e-book is an edited selection of my contributions to that volume.

Finally, I cannot but thank all those who helped me in the technical preparation of this e-book. Special thanks go to my husband for his consistent readiness to solve whatever computer challenges I faced at any time of the day or night. Additional thanks are due for his patience in listening to my unending ideas on technology, and a host of other subjects.

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Part One

COMMENT: The Dilemma of Technology

As a child growing up in Beirut, Lebanon, I was fascinated by the legend of how the Tyrian purple color was discovered and produced by the Phoenicians around 14th century B.C.E. The old city of Tyre was after all less than two hours' drive from Beirut, and its ancient history overwhelmed my imagination. Yet, one particular story stuck in my mind.My teacher told us that the king of Tyre and his queen took a stroll on the shores of Tyre with their dog. The dog strayed away from the couple only to come back with bright red-purple lips. The color was so stunning that the queen wanted her finest clothes to be made in that color.

This started a frantic search by her entourage to discover what made the lips of the royal dog turn into red-purple. The culprit, it turned out, was a Murex shellfish eaten by the dog. The talented Tyrians quickly figured out how to extract the dye from the shellfish, and the queen finally had herwish: clothes in what came to be known as the royal purple color. Thus, this romantic story had a happy ending. The queen got her wish, the king was happy, the dog had fun, and the world discovered a beautiful color as a result of this legendary stroll.

Years later, I came across the same story discussed in some detail from a historical perspective. According to this version, to replicate the red-purple color from seashells, the workers had to develop a complicated process that involved extracting the dye from the glands of thousands of Murex shellfish, devise a method to treat it, and then use it to dye cloth fibers.

Part of the treatment required leaving the crushed shellfish a longtime baking in the sun. The stench of the process was so strong that it affected Tyre's surrounding environment. Furthermore, it took 10,000 shellfish to produce one gram of the dye. As a result, the dye was worth more than its weight in gold. Nevertheless, the nobility and elites of the Mediterranean basin generated so much demand for the royal purple color that the Murex shells became almost extinct.

This story leads us to the persistent question: Is technique/technology good or bad? Is it a blessing to humanity or a Frankenstein monster gone wild? As recently as the pandemic year 2020, both fear and hope gripped the world population. Would the vaccines save humanity from the pandemic, or would those vaccines using novel methods result in greater damage to the human body, and ultimately to humanity? Simultaneously, conspiracy theories multiplied, reflecting a level of mistrust by the people of the decision makers.

Part I of this book provides a broad range of views about technology coming from multiple disciplines. While the articles belong to the past century, they are valuable insofar as they provide a foundation for today's discussions. They also reflect the complexity of the question posed, and the diversity of approaches and conclusions. Some articles are quite prescient about developments in this century. Given recent advances in biomedical and digital technology, it is not too absurd to conclude that humanity is at the verge of a radical transformation that may change its very nature and blur the line between *homo faber* and *homo fabricatus*.

SOME SALIENT VIEWS ON TECHNOLOGY

Toward a philosophy of technology

HANS JONAS

■ Hans Jonas *was born in 1903 in Mönchengladbach, Germany, and moved to the United States in 1955. He is a historian of philosophy and religion, with special interest in the ancient and medieval periods. He is also interested in the areas of technology and ethics, and in the philosophy of organism. He is presently the Alvin Johnson Professor of Philosophy Emeritus, Graduate Faculty, New School for Social Research, New York City. This article is adapted from Jonas' presentation on the occasion of his accepting the second Henry Knowles Beecher award, given by the Institute of Society, Ethics and the Life Sciences for lifetime contributions to ethics and the life sciences. Among his works are* The Phenomenon of Life *and* Philosophical Essays.

In this article Jonas defends the need for a philosophy of technology. Technology, he says, has become "the focal fact of modern life," and he gives striking examples of that fact. Jonas outlines three themes of interest to a philosophy of technology. The first is the formal *dynamics of technology, which "advances by its own 'laws of motion'." This, together with his assertions that "technology dominates our lives" and "technology is destiny," places Jonas on the side of Ellul in the Autonomous Technology Debate (see following article, and also Part Three). The second theme is the* substantive *content of technology—the things technology puts into human use, the powers it confers, and the objectives it makes possible or necessary. The third is the* moral *theme, which pertains to human responsibilities in the face of technological progress. Two salient points appear in the discussion of these themes. The first concerns a trait of modern technology—namely, the ever-continuing process of fitting ends to means. This trait is criticized by Hannah Arendt in "Instrumentality and* Homo Faber*" (see Part Three). The second point concerns the dialectic relation between science and technology.*

Are there philosophical aspects to technology? Of course there are, as there are to all things of importance in human endeavor and destiny. Modern technology touches on almost everything vital to man's existence—material, mental, and spiritual. Indeed, what of man is *not* involved? The way he lives his life and looks at objects, his intercourse with the world and with his peers, his powers and modes of action, kinds of goals, states and changes of society, objectives and forms of politics (including warfare no less than welfare), the sense and quality of life, even man's fate and that of his environment: all these are involved in the technological enterprise as it extends in magnitude and depth. The mere enumeration suggests a staggering host of potentially philosophic themes.

To put it bluntly: if there is a philosophy of science, language, history, and art; if there is social, political, and moral philosophy; philosophy of thought and of action, of reason and passion, of decision and value—all facets of the inclusive philosophy of man—how then could there not be a philosophy of technology, the focal fact of modern life? And at that a philosophy so spacious that it can house portions from all the other branches of philosophy? It is almost a truism, but at the same time so immense a proposition that its challenge staggers the mind. Economy and modesty require that we select, for a beginning, the most obvious from the mul-

☐ From *The Hastings Center Report*, 9, No. 1(1979), 34-43.

titude of aspects that invite philosophical attention.

The old but useful distinction of "form" and "matter" allows us to distinguish between these two major themes: (1) the *formal dynamics* of technology as a continuing collective enterprise, which advances by its own "laws of motion"; and (2) the *substantive content* of technology in terms of the things it puts into human use, the powers it confers, the novel objectives it opens up or dictates, and the altered manner of human action by which these objectives are realized.

The first theme considers technology as an abstract whole of movement; the second considers its concrete uses and their impact on our world and our lives. The formal approach will try to grasp the pervasive "process properties" by which modern technology propels itself—through our agency, to be sure—into ever-succeeding and superceding novelty. The material approach will look at the species of novelties themselves, their taxonomy, as it were, and try to make out how the world furnished with them looks. A third, overarching theme is the *moral* side of technology as a burden on human responsibility, especially its long-term effects on the global condition of man and environment. This—my own main preoccupation over the past years—will only be touched upon.

I. THE FORMAL DYNAMICS OF TECHNOLOGY

First some observations about technology's form as an abstract whole of movement. We are concerned with characteristics of *modern* technology and therefore ask first what distinguishes it *formally* from all previous technology. One major distinction is that modern technology is an enterprise and process, whereas earlier technology was a possession and a state. If we roughly describe technology as comprising the use of artificial implements for the business of life, together with their original invention, improvement, and occasional additions, such a tranquil description will do for most of technology through mankind's career (with which it is coeval), but not for modern technology. In the past, generally speaking, a given inventory of tools and procedures used to be fairly constant, tending toward a mutually adjusting, stable equilibrium of ends and means, which—once established—represented for lengthy periods an unchallenged optimum of technical competence.

To be sure, revolutions occurred, but more by accident than by design. The agricultural revolution, the metallurgical revolution that led from the neolithic to the iron age, the rise of cities, and such developments, *happened* rather than were consciously created. Their pace was so slow that only in the time-contraction of historical retrospect do they appear to be "revolutions" (with the misleading connotation that their contemporaries experienced them as such). Even where the change was sudden, as with the introduction first of the chariot, then of armed horsemen into warfare—a violent, if short-lived, revolution indeed—the innovation did not originate from within the military art of the advanced societies that it affected, but was thrust on it from outside by the (much less civilized) peoples of Central Asia. Instead of spreading through the technological universe of their time, other technical breakthroughs, like Phoenician purple-dying, Byzantine "greek fire," Chinese porcelain and silk, and Damascene steel-tempering, remained jealously guarded monopolies of the inventor communities. Still others, like the hydraulic and steam playthings of Alexandrian mechanics, or compass and gunpowder of the Chinese, passed unnoticed in their serious technological potentials.[1]

On the whole (not counting rare upheavals), the great classical civilizations had comparatively early reached a point of technological saturation—the aforementioned "optimum" in equilibrium of means with acknowledged needs and goals—and had little cause later to go beyond it. From there on, convention reigned supreme. From pottery to monumental architecture, from food growing to shipbuilding, from textiles to engines of war, from time measuring to stargazing: tools, techniques, and objectives remained essentially the same over long times; improvements were sporadic and unplanned. Progress therefore—if it occurred at all*—was

* Progress did, in fact, occur even at the heights of classical civilizations. The Roman arch and vault, for example, were distinct engineering advances over the horizontal entablature and flat ceiling of Greek (and Egyptian) architecture, permitting spanning feats and thereby construction objectives not contemplated before (stone bridges, aqueducts, the vast baths and other public halls of Imperial Rome). But materials, tools, and techniques were still the same, the role of human labor and crafts remained unaltered, stonecutting and brickbaking went on as before. An existing technology was enlarged in its scope of performance, but none of its means or even goals made obsolete.

by inconspicuous increments to a universally high level that still excites our admiration and, in historical fact, was more liable to regression than to surpassing. The former at least was the more noted phenomenon, deplored by the epigones with a nostalgic remembrance of a better past (as in the declining Roman world). More important, there was, even in the best and most vigorous times, no proclaimed *idea* of a future of *constant progress* in the arts. Most important, there was never a deliberate method of going about it like "research," the willingness to undergo the risks of trying unorthodox paths, exchanging information widely about the experience, and so on. Least of all was there a "natural science" as a growing body of theory to guide such semitheoretical, prepractical activities, plus their social institutionalization. In routines as well as panoply of instruments, accomplished as they were for the purposes they served, the "arts" seemed as settled as those purposes themselves.*

Traits of modern technology

The exact opposite of this picture holds for modern technology, and this is its first philosophical aspect. Let us begin with some manifest traits.

1. Every new step in whatever direction of whatever technological field tends *not* to approach an equilibrium or saturation point in the process of fitting means to ends (nor is it meant to), but, on the contrary, to give rise, if successful, to further steps in all kinds of direction and with a fluidity of the ends themselves. "Tends to" becomes a compelling "is bound to" with any major or important step (this almost being its criterion); and the innovators themselves expect, beyond the accomplishment, each time, of their immediate task, the constant future repetition of their inventive activity.

2. Every technical innovation is sure to spread quickly through the technological world community, as also do theoretical discoveries in the sciences. The spreading is in terms of knowledge and of practical adoption, the first (and its speed) guaranteed by the universal intercommunication that is itself part of the technological complex, the second enforced by the pressure of competition.

3. The relation of means to ends is not unilinear but circular. Familiar ends of long standing may find better satisfaction by new technologies whose genesis they had inspired. But equally—and increasingly typical—new technologies may suggest, create, even impose new ends, never before conceived, simply by offering their feasibility. (Who had ever wished to have in his living room the Philharmonic orchestra, or open heart surgery, or a helicopter defoliating a Vietnam forest? or to drink his coffee from a disposable plastic cup? or to have artificial insemination, test-tube babies, and host pregnancies? or to see clones of himself and others walking about?) Technology thus adds to the very objectives of human desires, including objectives for technology itself. The last point indicates the dialectics or circularity of the case: once incorporated into the socioeconomic demand diet, ends first gratuitously (perhaps accidentally) generated by technological invention become necessities of life and set technology the task of further perfecting the means of realizing them.

4. Progress, therefore, is not just an ideological gloss on modern technology, and not at all a mere option offered by it, but an inherent drive which acts willy-nilly in the formal automatics of its *modus operandi* as it interacts with society. "Progress" is here not a value term but purely descriptive. We may resent the fact and despise its fruits and yet must go along with it, for—short of a stop by the fiat of total political power, or by a sustained general strike of its clients or some internal collapse of their societies, or by self-destruction through its works (the last, alas, the least unlikely of these)—the juggernaut moves on relentlessly, spawning its always mutated progeny by coping with the challenges and lures of the now. But while not a value term, "progress" here is not a neutral term either, for which we could simply substitute "change." For it is in the nature of the case, or a law of the series, that a later stage is always, in terms of technology itself, *superior* to the preceding stage.* Thus we have here a case of the entropy-defying sort (organic evolution is another), where the internal motion of a system, left to itself and not interfered with,

*One meaning of "classical" is that those civilizations had somehow implicitly "defined" themselves and neither encouraged nor even allowed to pass beyond their innate terms. The—more or less—achieved "equilibrium" was their very pride.

*This only seems to be but is not a value statement, as the reflection on, for example, an ever more destructive atom bomb shows.

leads to ever "higher," not "lower" states of itself. Such at least is the present evidence.* If Napoleon once said, "Politics is destiny," we may well say today, "Technology is destiny."

These points go some way to explicate the initial statement that modern technology, unlike traditional, is an enterprise and not a possession, a process and not a state, a dynamic thrust and not a set of implements and skills. And they already adumbrate certain "laws of motion" for this restless phenomenon. What we have described, let us remember, were formal traits which as yet say little about the contents of the enterprise. We ask two questions of this descriptive picture: *why* is this so, that is, what *causes* the restlessness of modern technology; what is the nature of the thrust? And, what is the philosophical import of the facts so explained?

The nature of restless technology

As we would expect in such a complex phenomenon, the motive forces are many, and some causal hints appeared already in the descriptive account. We have mentioned *pressure of competition*—for profit, but also for power, security, and so forth—as one perpetual mover in the universal appropriation of technical improvements. It is equally operative in their origination, that is, in the process of invention itself, nowadays dependent on constant outside subsidy and even goal-setting: potent interests see to both. War, or the threat of it, has proved an especially powerful agent. The less dramatic, but no less compelling, everyday agents are legion. To keep one's head above the water is their common principle (somewhat paradoxical, in view of an abundance already far surpassing what former ages would have lived with happily ever after). Of pressures other than the competitive ones, we must mention those of population growth and of impending exhaustion of natural resources. Since both phenomena are themselves already by-products of technology (the first by way of medical improvements, the second by the voracity of industry), they offer a good example of the more general truth that to a considerable extent technology itself begets the problems which it is then called upon to overcome by a new forward jump. (The Green Revolution and the development of synthetic substitute materials or of alternate sources of energy come under this heading.) These compulsive pressures for progress, then, would operate even for a technology in a noncompetitive, for example, a socialist setting.

A motive force more autonomous and spontaneous than these almost mechanical pushes with their "sink or swim" imperative would be the pull of the quasi-utopian *vision* of an ever better life, whether vulgarly conceived or nobly, once technology had proved the open-ended capacity for procuring the conditions for it: perceived possibility whetting the appetite ("the American dream," "the revolution of rising expectations"). This less palpable factor is more difficult to appraise, but its playing a role is undeniable. Its deliberate fostering and manipulation by the dream merchants of the industrial-mercantile complex is yet another matter and somewhat taints the spontaneity of the motive, as it also degrades the quality of the dream. It is also moot to what extent the vision itself is *post hoc* rather than *ante hoc*, that is, instilled by the dazzling feats of a technological progress already underway and thus more a response to than a motor of it.

Groping in these obscure regions of motivation, one may as well descend, for an explanation of the dynamism as such, into the Spenglerian mystery of a "Faustian soul" innate in Western culture, that drives it, nonrationally, to infinite novelty and unplumbed possibilities for their own sake; or into the Heideggerian depths of a fateful, metaphysical decision of the will for boundless power over the world of things—a decision equally peculiar to the Western mind: speculative intuitions which do strike a resonance in us, but are beyond proof and disproof.

Surfacing once more, we may also look at the very sober, functional facts of industrialism as such, of production and distribution, output maximization, managerial and labor aspects, which even apart from competitive pressure provide their own incentives for technical progress. Similar observations apply to the requirements of *rule* or control in the vast and populous states of our time, those giant territorial superorganisms which for their very cohesion depend on advanced technology (for example, in information, communication, and transportation, not

*There may conceivably be internal degenerative factors—such as the overloading of finite information-processing capacity—that may bring the (exponential) movement to a halt or even make the system fall apart. We don't know yet.

to speak of weaponry) and thus have a stake in its promotion: the more so, the more centralized they are. This holds for socialist systems no less than for free-market societies. May we conclude from this that even a communist world state, freed from external rivals as well as from internal free-market competition, might still have to push technology ahead for purposes of control on this colossal scale? Marxism, in any case, has its own inbuilt commitment to technological progress beyond necessity. But even disregarding all dynamics of these conjectural kinds, the most monolithic case imaginable would, at any rate, still be exposed to those noncompetitive, natural pressures like population growth and dwindling resources that beset industrialism as such. Thus, it seems, the compulsive element of technological progress may not be bound to its original breeding ground, the capitalist system. Perhaps the odds for an eventual stabilization look somewhat better in a socialist system, provided it is worldwide—and possibly totalitarian in the bargain. As it is, the pluralism we are thankful for ensures the constancy of compulsive advance.

We could go on unravelling the causal skein and would be sure to find many more strands. But none nor all of them, much as they explain, would go to the heart of the matter. For all of them have one premise in common without which they could not operate for long: the premise that there *can* be indefinite progress because there *is* always something new and better to find. The, by no means obvious, givenness of this objective condition is also the pragmatic conviction of the performers in the technological drama; but without its being true, the conviction would help as little as the dream of the alchemists. Unlike theirs, it is backed up by an impressive record of past successes, and for many this is sufficient ground for their belief. (Perhaps holding or not holding it does not even greatly matter.) What makes it more than a sanguine belief, however, is an underlying and well-grounded, theoretical view of the nature of things and of human cognition, according to which they do not set a limit to novelty of discovery and invention, indeed, that they of themselves will at each point offer another opening for the as yet unknown and undone. The corollary conviction, then, is that a technology tailored to a nature and to a knowledge of this indefinite potential ensures its indefinitely continued conversion into the practical powers, each step of it begetting the next, with never a cutoff from internal exhaustion of possibilities.

Only habituation dulls our wonder at this wholly unprecedented belief in virtual "infinity." And by all our present comprehension of reality, the belief is most likely true—at least enough of it to keep the road for innovative technology in the wake of advancing science open for a long time ahead. Unless we understand this ontologic-epistomological premise, we have not understood the inmost agent of technological dynamics, on which the working of all the adventitious causal factors is contingent in the long run.

Let us remember that the virtual infinitude of advance we here seek to explain is in essence different from the always avowed perfectibility of every human accomplishment. Even the undisputed master of his craft always had to admit as possible that he might be surpassed in skill or tools or materials; and no excellence of product ever foreclosed that it might still be bettered, just as today's champion runner must know that his time may one day be beaten. But these are improvements within a given genus, not different in kind from what went before, and they must accrue in diminishing fractions. Clearly, the phenomenon of an exponentially growing *generic* innovation is qualitatively different.

Science as a source of restlessness

The answer lies in the interaction of *science* and *technology* that is the hallmark of modern progress, and thus ultimately in the kind of nature which modern science progressively discloses. For it is here, in the movement of *knowledge*, where relevant novelty first and constantly occurs. This is itself a novelty. To Newtonian physics, nature appeared simple, almost crude, running its show with a few kinds of basic entities and forces by a few universal laws, and the application of those well-known laws to an ever greater variety of composite phenomena promised ever widening knowledge indeed, but no real surprises. Since the mid-nineteenth century, this minimalistic and somehow finished picture of nature has changed with breathtaking acceleration. In a reciprocal interplay with the growing subtlety of exploration (instrumental and conceptual), nature itself stands forth as ever more subtle. The progress of probing makes the object grow richer in modes of operation, not sparer as classical mechanics had expected. And instead of narrowing the margin of the still-undiscovered, science now surprises itself with unlocking dimension after dimension of new depths. The very essence of matter has turned from a blunt, irreducible ultimate to an always reopened challenge for further penetration. No one can say whether this will go on forever, but a suspicion of intrinsic infinity in the very being of things obtrudes itself and therewith an anticipation of unending inquiry of the sort where succeeding steps will not find the same old story again (Descartes' "matter in motion"), but always add new twists to it. If then the art of technology is correlative to the knowledge of nature, technology too acquires from this source that potential of infinity for its innovative advance.

But it is not just that indefinite scientific progress offers the *option* of indefinite technological progress, to be exercised or not as other interests see fit. Rather the cognitive process itself moves by interaction with the technological, and in the most internally vital sense: for its own *theoretical* purpose, science must generate an increasingly sophisticated and physically formidable technology as its tool. What it finds with this help initiates new departures in the practical sphere, and the latter as a whole, that is, technology at work provides with its experiences a large-scale laboratory for science again, a breeding ground for new questions, and so on in an unending cycle. In brief, a mutual feedback operates between science and technology; each requires and propels the other; and as matters now stand, they can only live together or must die together. For the dynamics of technology, with which we are here concerned, this means that (all external promptings apart) an agent of restlessness is implanted in it by its functionally integral bond with science. As long, therefore, as the cognitive impulse lasts, technology is sure to move ahead with it. The cognitive impulse, in its turn, culturally vulnerable in itself, liable to lag or to grow conservative with a treasured canon—that theoretical eros itself no longer lives on the delicate appetite for truth alone, but is spurred on by its hardier offspring, technology, which communicates to it impulsions from the broadest arena of struggling, insistent life. Intellectual curiosity is seconded by interminably self-renewing practical aim.

I am conscious of the conjectural character of some of these thoughts. The revolutions in science over the last fifty years or so are a fact, and so are the revolutionary style they imparted to technology and the reciprocity between the two concurrent streams (nuclear physics is a good example). But whether those scientific revolutions, which hold primacy in the whole syndrome, will be typical for science henceforth—something like a law of motion for its future—or represent only a singular phase in its longer run, is unsure. To the extent, then, that our forecast of incessant novelty for technology was predicated on a guess concerning the future of science, even concerning the nature of things, it is hypothetical, as such extrapolations are bound to be. But even if the recent past did not usher in a state of permanent revolution for science, and the life of theory settles down again to a more sedate pace, the scope for technological innovation will not easily shrink; and what may no longer be a revolution in science, may still revolutionize our lives in its practical impact through technology. "Infinity" being too large a word anyway, let us say that present signs of potential and of incentives point to an indefinite perpetuation and fertility of the technological momentum.

The philosophical implications

It remains to draw philosophical conclusions from our findings, at least to pinpoint aspects of philosophical interest. Some preceding remarks have already been straying into philosophy of science in the technical sense. Of broader issues, two will be ample to provide food for further thought beyond the limitations of this paper. One concerns the status of knowledge in the human scheme, the other the status of technology itself as a human goal, or its tendency to become that from being a means, in a dialectical inversion of the means-end order itself.

Concerning knowledge, it is obvious that the time-honored division of theory and practice has vanished for both sides. The thirst for pure knowledge may persist undiminished, but the involvement of knowing at the heights with doing in the lowlands of life, mediated by technology, has become inextricable; and the aristocratic self-sufficiency of knowing for its own (and the knower's) sake has gone. Nobility has been exchanged for utility. With the possible exception of philosophy, which still can do with paper and pen and tossing thoughts around among peers, all knowledge has become thus tainted, or elevated if you will, whether utility is intended or not. The technological syndrome, in other words, has brought about a thorough *socializing* of the theoretical realm, enlisting it in the service of common need. What used to be the freest of human choices, an extravagance snatched from the pressure of the world—the esoteric life of thought—has become part of the great public play of necessities and a prime necessity in the action of the play.* Remotest abstraction has become enmeshed with nearest concreteness. What this pragmatic functionalization of the once highest indulgence in impractical pursuits portends for the image of man, for the restructuring of a hallowed hierarchy of values, for the idea of "wisdom," and so on, is surely a subject for philosophical pondering.

Concerning technology itself, its actual role in modern life (as distinct from the purely instrumental definition of technology as such) has made the relation of means and ends equivocal all the way up from the daily living to the very vocation of man. There could be no question in former technology that its role was that of humble servant—pride of workmanship and esthetic embellishment of the useful notwithstanding. The Promethean enterprise of modern technology speaks a different language. The word "enterprise" gives the clue, and its unendingness another. We have mentioned that the effect of its innovations is disequilibrating rather than equilibrating with respect to the balance of wants and supply, always breeding its own new wants. This in itself compels the constant attention of the best minds, engaging the full capital of human ingenuity for meeting challenge after challenge and seizing the new chances. It is psychologically natural for that degree of engagement to be invested with the dignity of dominant purpose. Not only does technology dominate our lives in fact, it nourishes also a belief in its being of predominant worth. The sheer grandeur of the enterprise and its seeming infinity inspire enthusiasm and fire ambition. Thus, in addition to spawning new ends (worthy or frivolous) from the mere invention of means, technology as a grand venture tends to establish *itself* as the transcendent end. At least the suggestion is there and casts its spell on the modern mind. At its most modest, it means elevating *homo faber* to the essential aspect of man; at its most extravagant, it means elevating *power* to the position of his dominant and interminable goal. To become ever more masters of the world, to advance from power to power, even if only collectively and perhaps no longer by choice, *can* now be seen to be the chief vocation of mankind. Surely, this again poses philosophical questions that may well lead unto the uncertain grounds of metaphysics or of faith.

I here break off, arbitrarily, the formal account of the technological movement in general, which as yet has told us little of what the enterprise is about. To this subject I now turn, that is, to the new kinds of powers and objectives that technology opens to modern man and the consequently altered quality of human action itself.

II. THE MATERIAL WORKS OF TECHNOLOGY

Technology is a species of power, and we can ask questions about how and on what object any power is exercised. Adopting Aristotle's rule in *de anima* that for understanding a faculty one should begin with its objects, we start from them too—"objects" meaning both the visible *things* technology generates and puts into human use, and the *objectives* they serve. The objects of modern technology are first everything that had always been an object of human artifice and labor: food, clothing, shelter, implements, transportation—all the material necessities and comforts of life. The technological intervention changed at first not the product but its production, in speed, ease, and quantity. However, this is true only of the very first stage of the industrial revolution with which large-scale scientific technology began. For example, the cloth for the steam-driven looms of Lancashire remained the same. Even then, one significant new product was added to the traditional list—the machines themselves, which required an entire new industry with further subsidiary industries to build them. These novel entities, machines—at first capital goods only, not consumer goods—had from the beginning their

*There is a paradoxical side effect to this change of roles. That very science which forfeited its place in the domain of leisure to become a busy toiler in the field of common needs, creates by its toils a growing domain of leisure for the masses, who reap this with the other fruits of technology as an additional (and no less novel) article of forced consumption. Hence leisure, from a privilege of the few, has become a problem for the many to cope with. Science, not idle, provides for the needs of this idleness too: no small part of technology is spent on filling the leisure-time gap which technology itself has made a fact of life.

own impact on man's symbiosis with nature by being consumers themselves. For example: steam-powered water pumps facilitated coal mining, required in turn extra coal for firing their boilers, more coal for the foundries and forges that made those boilers, more for the mining of the requisite iron ore, more for its transportation to the foundries, more—both coal and iron—for the rails and locomotives made in these same foundries, more for the conveyance of the foundries' product to the pitheads and return, and finally more for the distribution of the more abundant coal to the users outside this cycle, among which were increasingly still more machines spawned by the increased availability of coal. Lest it be forgotten over this long chain, we have been speaking of James Watt's modest steam engine for pumping water, out of mine shafts. This syndrome of self-proliferation—by no means a linear chain but an intricate web of reciprocity—has been part of modern technology ever since. To generalize, technology exponentially increases man's drain on nature's resources (of substances and of energy), not only through the multiplication of the final goods for consumption, but also, and perhaps more so, through the production and operation of its own mechanical means. And with these means—machines—it introduced a new category of goods, not for consumption, added to the furniture of our world. That is, among the objects of technology a prominent class is that of technological apparatus itself.

Soon other features also changed the initial picture of a merely mechanized production of familiar commodities. The final products reaching the consumer ceased to be the same, even if still serving the same age-old needs; new needs, or desires, were added by commodities of entirely new kinds which changed the habits of life. Of such commodities, machines themselves became increasingly part of the consumer's daily life to be used directly by himself, as an article not of production but of consumption. My survey can be brief as the facts are familiar.

New kinds of commodities

When I said that the cloth of the mechanized looms of Lancashire remained the same, everyone will have thought of today's synthetic fibre textiles for which the statement surely no longer holds. This is fairly recent, but the general phenomenon starts much earlier, in the synthetic dyes and fertilizers with which the chemical industry—the first to be wholly a fruit of science—began. The original rationale of these technological feats was substitution of artificial for natural materials (for reasons of scarcity or cost), with as nearly as possible the same properties for effective use. But we need only think of plastics to realize that art progressed from substitutes to the creation of really new substances with properties not so found in any natural one, raw or processed, thereby also initiating uses not thought of before and giving rise to new classes of objects to serve them. In chemical (molecular) engineering, man does more than in mechanical (molar) engineering which constructs machinery from natural materials; his intervention is deeper, redesigning the infra-patterns of nature, making substances to specification by arbitrary disposition of molecules. And this, be it noted, is done deductively from the bottom, from the thoroughly analyzed last elements, that is, in a real *via compositiva* after the completed *via resolutiva,* very different from the long-known empirical practice of coaxing substances into new properties, as in metal alloys from the bronze age on. Artificiality or creative engineering with abstract construction invades the heart of matter. This, in molecular biology, points to further, awesome potentialities.

With the sophistication of molecular alchemy we are ahead of our story. Even in straightforward hardware engineering, right in the first blush of the mechanical revolution, the objects of use that came out of the factories did not really remain the same, even where the objectives did. Take the old objective of travel. Railroads and ocean liners are relevantly different from the stage coach and from the sailing ship, not merely in construction and efficiency but in the very feel of the user, making travel a different experience altogether, something one may do for its own sake. Airplanes, finally, leave behind any similarity with former conveyances, except the purpose of getting from here to there, with no experience of what lies in between. And these instrumental objects occupy a prominent, even obtrusive place in our world, far beyond anything wagons and boats ever did. Also they are constantly subject to improvement of design, with obsolescence rather than wear determining their life span.

Or take the oldest, most static of artifacts: human habitation. The multistoried office building of steel, concrete, and glass is a qualitatively different entity from the wood, brick, and stone structures of old. With all that goes into it besides the structures as such—the plumbing and wiring, the elevators, the lighting, heating, and cooling systems—it embodies the end products of a whole spectrum of technologies and far-flung industries, where only at the remote sources human hands still meet with primary materials, no longer recognizable in the final result. The ultimate customer inhabiting the product is ensconced in a shell of thoroughly derivative artifacts (perhaps relieved by a nice piece of driftwood). This transformation into utter artificiality is generally, and increasingly, the effect of technology on the human environment, down to the items of daily use. Only in agriculture has the product so far escaped this transformation by the changed modes of its production. We still eat the meat and rice of our ancestors.*

Then, speaking of the commodities that technology injects into private use, there are machines themselves, those very devices of its own running, originally confined to the economic sphere. This unprecedented novum in the records of individual living started late in the nineteenth century and has since grown to a pervading mass phenomenon in the Western world. The prime example, of course, is the automobile, but we must add to it the whole gamut of household appliances—refrigerators, washers, dryers, vacuum cleaners—by now more common in the lifestyle of the general population than running water or central heating were one hundred years ago. Add lawn mowers and other power tools for home and garden; we are mechanized in our daily chores and recreations (including the toys of our children) with every expectation that new gadgets will continue to arrive.

These paraphernalia are machines in the precise sense that they perform work and consume energy, and their moving parts are of the familiar magnitudes of our perceptual world. But an additional and profoundly different category of technical apparatus was dropped into the lap of the private citizen, not labor-saving and work-performing, partly not even utilitarian, but—with minimal energy input—catering to the senses and the mind: telephone, radio, television, tape recorders, calculators, record players—all the domestic terminals of the electronics industry, the latest arrival on the technological scene. Not only by their insubstantial, mind-addressed output, also by the subvisible, not literally "mechanical" physics of their functioning do these devices differ in kind from all the macroscopic, bodily moving machinery of the classical type. Before inspecting this momentous turn from power engineering, the hallmark of the first industrial revolution, to communication engineering, which almost amounts to a second industrial-technological revolution, we must take a look at its natural base: electricity.

In the march of technology to ever greater artificiality, abstraction, and subtlety, the unlocking of electricity marks a decisive step. Here is a universal force of nature which yet does not naturally appear to man (except in lightning). It is not a datum of uncontrived experience. Its very "appearance" had to wait for science, which contrived the experience for it. Here, then, a technology depended on science for the mere providing of its "object," the entity itself it would deal with—the first case where theory alone, not ordinary experience, wholly preceded practice (repeated later in the case of nuclear energy). And what sort of entity! Heat and steam are familiar objects of sensuous experience, their force bodily displayed in nature; the matter of chemistry is still the concrete, corporeal stuff mankind had always known. But electricity is an abstract object, disembodied, immaterial, unseen; in its usable form, it is entirely an artifact, generated in a subtle transformation from grosser forms of energy (ultimately from heat via motion). Its theory indeed had to be essentially complete before utilization could begin.

Revolutionary as electrical technology was in itself, its purpose was at first the by now conventional one of the industrial revolution in general: to supply motive power for the propulsion of machines. Its advantages lay in the unique versatility of the new force, the ease of its transmission, transformation and distribution—an unsubstantial commodity, no bulk, no weight, instantaneously delivered at the point of consumption. Nothing like it had ever existed before in man's traffic with matter, space, and

*Not so, objects my colleague Robert Heilbroner in a letter to me; "I'm sorry to tell you that meat and rice are both *profoundly* influenced by technology. Not even they are left untouched." Correct, but they are at least generically the same (their really profound changes lie far back in the original breeding of domesticated strains from wild ones—as in the case of all cereal plants under cultivation). I am speaking here of an order of transformation in which the results bear no resemblance to the natural materials at their source, nor to any naturally occurring state of them.

time. It made possible the spread of mechanization to every home; this alone was a tremendous boost to the technological tide, at the same time hooking private lives into centralized public networks and thus making them dependent on the functioning of a total system as never before, in fact, for every moment. Remember, you cannot hoard electricity as you can coal and oil, or flour and sugar for that matter.

But something much more unorthodox was to follow. As we all know, the discovery of the universe of electromagnetics caused a revolution in theoretical physics that is still underway. Without it, there would be no relativity theory, no quantum mechanics, no nuclear and subnuclear physics. It also caused a revolution in technology beyond what it contributed, as we noted, to its classical program. The revolution consisted in the passage from electrical to electronic technology which signifies a new level of abstraction in means and ends. It is the difference between power and communication engineering. Its object, the most impalpable of all, is information. Cognitive instruments had been known before—sextant, compass, clock, telescope, microscope, thermometer, all of them for information and not for work. At one time, they were called "philosophical" or "metaphysical" instruments. By the same general criterion, amusing as it may seem, the new electronic information devices, too, could be classed as "philosophical instruments." But those earlier cognitive devices, except the clock, were inert and passive, not generating information actively, as the new instrumentalities do.

Theoretically as well as practically, electronics signifies a genuinely new phase of the scientific-technological revolution. Compared with the sophistication of its theory as well as the delicacy of its apparatus, everything which came before seems crude, almost natural. To appreciate the point, take the man-made satellites now in orbit. In one sense, they are indeed an imitation of celestial mechanics—Newton's laws finally verified by cosmic experiment: astronomy, for millenia the most purely contemplative of the physical sciences, turned into a practical art! Yet, amazing as it is, the astronomic imitation, with all the unleashing of forces and the finesse of techniques that went into it, is the least interesting aspect of those entities. In that respect, they still fall within the terms and feats of classical mechanics (except for the remote-control course corrections).

Their true interest lies in the instruments they carry through the voids of space and in what these do, their measuring, recording, analyzing, computing, their receiving, processing, and transmitting abstract information and even images over cosmic distances. There is nothing in all nature which even remotely foreshadows the kind of things that now ride the heavenly spheres. Man's imitative practical astronomy merely provides the vehicle for something else with which he sovereignly passes beyond all the models and usages of known nature.* That the advent of man portended, in its inner secret of mind and will, a cosmic event was known to religion and philosophy: now it manifests itself as such by fact of things and acts in the visible universe. Electronics indeed creates a range of objects imitating nothing and progressively added to by pure invention.

And no less invented are the ends they serve. Power engineering and chemistry for the most part still answered to the natural needs of man: for food, clothing, shelter, locomotion, and so forth. Communication engineering answers to needs of information and control solely created by the civilization that made this technology possible and, once started, imperative. The novelty of the means continues to engender no less novel ends—both becoming as necessary to the functioning of the civilization that spawned them as they would have been pointless for any former one. The world they help to constitute and which needs computers for its very running is no longer nature supplemented, imitated, improved, transformed, the original habitat made more habitable. In the pervasive mentalization of physical relationships it is a *trans-nature* of human making, but with this inherent paradox: that it threatens the obsolescence of man himself, as increasing automation ousts him from the places of work where he formerly proved his humanhood. And there is a further threat: its strain on nature herself may reach a breaking point.

The last stage of the revolution?

That sentence would make a good dramatic ending. But it is not the end of the story. There

*Note also that in radio technology, the medium of action is nothing material, like wires conducting currents, but the entirely immaterial electromagnetic "field," i.e., space itself. The symbolic picture of "waves" is the last remaining link to the forms of our perceptual world.

may be in the offing another, conceivably the last, stage of the technological revolution, after the mechanical, chemical, electrical, electronic stages we have surveyed, and the nuclear we omitted. All these were based on physics and had to do with what man can put to his use. What about biology? And what about the user himself? Are we, perhaps, on the verge of a technology, based on biological knowledge and wielding an engineering art which, this time, has man himself for its object? This has become a theoretical possibility with the advent of molecular biology and its understanding of genetic programming; and it has been rendered morally possible by the metaphysical neutralizing of man. But the latter, while giving us the license to do as we wish, at the same time denies us the guidance for knowing what to wish. Since the same evolutionary doctrine of which genetics is a cornerstone has deprived us of a valid image of man, the actual techniques, when they are ready, may find us strangely unready for their responsible use. The anti-essentialism of prevailing theory, which knows only of *de facto* outcomes of evolutionary accident and of no valid essences that would give sanction to them, surrenders our being to a freedom without norms. Thus the technological call of the new microbiology is the twofold one of physical feasibility and metaphysical admissibility. Assuming the genetic mechanism to be completely analyzed and its script finally decoded, we can set about rewriting the text. Biologists vary in their estimates of how close we are to the capability; few seem to doubt the right to use it. Judging by the rhetoric of its prophets, the idea of taking our evolution into our own hands is intoxicating even to many scientists.

In any case, the idea of making over man is no longer fantastic, nor interdicted by an inviolable taboo. If and when *that* revolution occurs, if technological power is really going to tinker with the elemental keys on which life will have to play its melody in generations of men to come (perhaps the only such melody in the universe), then a reflection on what is humanly desirable and what should determine the choice—a reflection, in short, on the image of man, becomes an imperative more urgent than any ever inflicted on the understanding of mortal man. Philosophy, it must be confessed, is sadly unprepared for this, its first cosmic task.

III. TOWARD AN ETHICS OF TECHNOLOGY

The last topic has moved naturally from the descriptive and analytic plane, on which the objects of technology are displayed for inspection, onto the evaluative plane where their ethical challenge poses itself for decision. The particular case forced the transition so directly because there the (as yet hypothetical) technological object was man directly. But once removed, man is involved in all the other objects of technology, as these singly and jointly remake the worldly frame of his life, in both the narrower and the wider of its senses: that of the artificial frame of civilization in which social man leads his life proximately, and that of the natural terrestrial environment in which this artifact is embedded and on which it ultimately depends.

Again, because of the magnitude of technological effects on both these vital environments in their totality, both the quality of human life and its very preservation in the future are at stake in the rampage of technology. In short, certainly the "image" of man, and possibly the survival of the species (or of much of it), are in jeopardy. This would summon man's duty to his cause even if the jeopardy were not of his own making. But it is, and, in addition to his ageless obligation to meet the threat of things, he bears for the first time the responsibility of prime agent in the threatening disposition of things. Hence nothing is more natural than the passage from the objects to the ethics of technology, from the things made to the duties of their makers and users.

A similar experience of inevitable passage from analysis of fact to ethical significance, let us remember, befell us toward the end of the first section. As in the case of the matter, so also in the case of the form of the technological dynamics, the image of man appeared at stake. In view of the quasi-automatic compulsion of those dynamics, with their perspective of indefinite progression, every existential and moral question that the objects of technology raise assumes the curiously eschatological quality with which we are becoming familiar from the extrapolating guesses of futurology. But apart from thus raising all challenges of present particular matter to the higher powers of future exponential magnification, the despotic dynamics of the technological movement as such, sweeping its captive movers along in its breathless momentum, poses its own questions to man's axiological conception of himself. Thus, form and matter of technology alike enter into the dimension of ethics.

The questions raised for ethics by the objects of technology are defined by the major areas of their impact and thus fall into such fields of knowledge as ecology (with all its biospheric subdivisions of land, sea, and air), demography economics, biomedical and behavioral sciences (even the psychology of mind pollution by television), and so forth. Not even a sketch of the substantive problems, let alone of ethical policies for dealing with them, can here be attempted. Clearly, for a normative rationale of the latter, ethical theory must plumb the very foundations of value, obligation, and the human good.

The same holds of the different kind of questions raised for ethics by the sheer fact of the formal dynamics of technology. But here, a question of another order is added to the straightforward ethical questions of both kinds, subjecting any resolution of them to a pragmatic proviso of harrowing uncertainty. Given the mastery of the creation over its creators, which yet does not abrogate their responsibility nor silence their vital interest, what are the chances and what are the means of gaining *control* of the process, so that the results of any ethical (or even purely prudential) insights can be translated into effective action? How in short can man's freedom prevail against the determinism he has created for himself? On this most clouded question, whereby hangs not only the effectuality or futility of the ethical search which the facts invite (assuming it to be blessed with *theoretical* success!), but perhaps the future of mankind itself, I will make a few concluding, but—alas—inconclusive, remarks. They are intended to touch on the whole ethical enterprise.

Problematic preconditions of an effective ethics

First, a look at the novel state of determinism. Prima facie, it would seem that the greater and more varied powers bequeathed by technology have expanded the range of choices and hence increased human freedom. For economics, for example, the argument has been made[2] that the uniform compulsion which scarcity and subsistence previously imposed on economic behavior with a virtual denial of alternatives (and hence—conjoined with the universal "maximization" motive of capitalist market competition—gave classical economics at least the appearance of a deterministic "science") has given way to a latitude of indeterminacy. The plenty and powers provided by industrial technology allow a pluralism of choosable alternatives (hence disallow scientific prediction). We are not here concerned with the status of economics as a science. But as to the altered state of things alleged in the argument, I submit that the change means rather that one, relatively homogeneous determinism (thus relatively easy to formalize into a law) has been supplanted by another, more complex, multifarious determinism, namely, that exercised by the human artifact itself upon its creator and user. We, abstractly speaking the possessors of those powers, are concretely subject to their emancipated dynamics and the sheer momentum of our own multitude, the vehicle of those dynamics.

I have spoken elsewhere[3] of the "new realm of necessity" set up, like a second nature, by the feedbacks of our achievements. The almighty we, or Man personified is, alas, an abstraction. *Man* may have become more powerful; *men* very probably the opposite, enmeshed as they are in more dependencies than ever before. What ideal Man now can do is not the same as what real men permit or dictate to be done. And here I am thinking not only of the immanent dynamism, almost automatism, of the impersonal technological complex I have invoked so far, but also of the pathology of its client society. Its compulsions, I fear, are at least as great as were those of unconquered nature. Talk of the blind forces of nature! Are those of the sorcerer's creation less blind? They differ indeed in the serial shape of their causality: the action of nature's forces is cyclical, with periodical recurrence of the same, while that of the technological forces is linear, progressive, cumulative, thus replacing the curse of constant toil with the threat of maturing crisis and possible catastrophe. Apart from this significant vector difference, I seriously wonder whether the tyranny of fate has not become greater, the latitude of spontaneity smaller; and whether man has not actually been weakened in his decision-making capacity by his accretion of collective strength.

However, in speaking, as I have just done, of "his" decision-making capacity, I have been guilty of the same abstraction I had earlier criticized in the use of the term "man." Actually, the subject of the statement was no real or representative individual but Hobbes' "Artificial

Man," "that great Leviathan, called a Common-Wealth," or the "large horse" to which Socrates likened the city, "which because of its great size tends to be sluggish and needs stirring by a gadfly." Now, the chances of there being such gadflies among the numbers of the commonwealth are today no worse nor better than they have ever been, and in fact they are around and stinging in our field of concern. In that respect, the free spontaneity of personal insight, judgment, and responsible action by speech can be trusted as an ineradicable (if also incalculable) endowment of humanity, and smallness of number is in itself no impediment to shaking public complacency. The problem, however, is not so much complacency or apathy as the counterforces of active, and anything but complacent, interests and the complicity with them of all of us in our daily consumer existence. These interests themselves are factors in the determinism which technology has set up in the space of its sway. The question, then, is that of the possible chances of unselfish insight in the arena of (by nature) selfish *power*, and more particularly: of one long-range, interloping insight against the short-range goals of many incumbent powers. Is there hope that wisdom itself can become power? This renews the thorny old subject of Plato's philosopher-king and—with that inclusion of realism which the utopian Plato did not lack—of the role of myth, not knowledge, in the education of the guardians. Applied to our topic: the *knowledge* of objective dangers and of values endangered, as well as of the technical remedies, is beginning to be there and to be disseminated; but to make it prevail in the marketplace is a matter less of the rational dissemination of truth than of public relations techniques, persuasion, indoctrination, and manipulation, also of unholy alliances, perhaps even conspiracy. The philosopher's descent into the cave may well have to go all the way to "if you can't lick them, join them."

That is so not merely because of the active resistance of special interests but because of the optical illusion of the near and the far which condemns the long-range view to impotence against the enticement and threats of the nearby: it is this incurable shortsightedness of animal-human nature more than ill will that makes it difficult to move even those who have no special axe to grind, but still are in countless ways, as we all are, beneficiaries of the untamed system and so have something dear in the present to lose with the inevitable cost of its taming. The taskmaster, I fear, will have to be actual pain beginning to strike, when the far has moved close to the skin and has vulgar optics on its side. Even then, one may resort to palliatives of the hour. In any event, one should try as much as one can to forestall the advent of emergency with its high tax of suffering or, at the least, prepare for it. This is where the scientist can redeem his role in the technological estate.

The incipient knowledge about technological danger trends must be developed, coordinated, systematized, and the full force of computer-aided projection techniques be deployed to determine priorities of action, so as to inform preventive efforts wherever they can be elicited, to minimize the necessary sacrifices, and at the worst to preplan the saving measures which the terror of beginning calamity will eventually make people willing to accept. Even now, hardly a decade after the first stirrings of "environmental" consciousness, much of the requisite knowledge, plus the rational persuasion, is available inside and outside academia for any well-meaning powerholder to draw upon. To this, we—the growing band of concerned intellectuals—ought persistently to contribute our bit of competence and passion.

But the real problem is to get the well-meaning into power and have that power as little as possible beholden to the interests which the technological colossus generates on its path. It is the problem of the philosopher-king compounded by the greater magnitude and complexity (also sophistication) of the forces to contend with. Ethically, it becomes a problem of playing the game by its impure rules. For the servant of truth to join in it means to sacrifice some of his time-honored role: he may have to turn apostle or agitator or political operator. This raises moral questions beyond those which technology itself poses, that of sanctioning immoral means for a surpassing end, of giving unto Caesar so as to promote what is not Caesar's. It is the grave question of moral casuistry, or of Dostoevsky's Grand Inquisitor, or of regarding cherished liberties as no longer affordable luxuries (which may well bring the anxious friend of mankind into odious political company)—questions one excusably hesitates to touch but in the further tide of things may not be permitted to evade.

What is, prior to joining the fray, the role of philosophy, that is, of a philosophically grounded ethical knowledge, in all this? The somber note of the last remarks responded to the quasi-apocalyptic prospects of the technological tide, where stark issues of planetary survival loom ahead. There, no philosophical ethics is needed to tell us that disaster must be averted. Mainly, this is the case of the ecological dangers. But there are other, noncatastrophic things afoot in technology where not the existence but the image of man is at stake. They are with us now and will accompany us and be joined by others at every new turn technology may take. Mainly, they are in the biomedical, behavioral, and social fields. They lack the stark simplicity of the survival issue, and there is none of the (at least declaratory) unanimity on them which the spectre of extreme crisis commands. It is here where a philosophical ethics or theory of values has its task. Whether its voice will be listened to in the dispute on policies is not for it to ask; perhaps it cannot even muster an authoritative voice with which to speak—a house divided, as philosophy is. But the philosopher must try for normative knowledge, and if his labors fall predictably short of producing a compelling axiomatics, at least his clarifications can counteract rashness and make people pause for a thoughtful view.

Where not existence but "quality" of life is in question, there is room for honest dissent on goals, time for theory to ponder them, and freedom from the tyranny of the lifeboat situation. Here, philosophy can have its try and its say. Not so on the extremity of the survival issue. The philosopher, to be sure, will also strive for a theoretical grounding of the very proposition that there ought to be men on earth, and that present generations are obligated to the existence of future ones. But such esoteric, ultimate validation of the perpetuity imperative for the species—whether obtainable or not to the satisfaction of reason—is happily not needed for consensus in the face of ultimate threat. Agreement in favor of life is pretheoretical, instinctive, and universal. Averting disaster takes precedence over everything else, including pursuit of the good, and suspends otherwise inviolable prohibitions and rules. All moral standards for individual or group behavior, even demands for individual sacrifice of life, are premised on the continued existence of human life. As I have said elsewhere,[4] "No rules can be devised for the waiving of rules in extremities. As with the famous shipwreck examples of ethical theory, the less said about it, the better."

Never before was there cause for considering the contingency that all mankind may find itself in a lifeboat, but this is exactly what we face when the viability of the planet is at stake. Once the situation becomes desperate, then what there is to do for salvaging it must be done, so that there be life—which "then," after the storm has been weathered, can again be adorned by ethical conduct. The moral inference to be drawn from this lurid eventuality of a moral pause is that we must never allow a lifeboat situation for humanity to arise.[5] One part of the ethics of technology is precisely to guard the space in which any ethics can operate. For the rest, it must grapple with the cross-currents of value in the complexity of life.

A final word on the question of determinism versus freedom which our presentation of the technological syndrome has raised. The best hope of man rests in his most troublesome gift: the spontaneity of human acting which confounds all prediction. As the late Hannah Arendt never tired of stressing: the continuing arrival of newborn individuals in the world assures ever-new beginnings. We should expect to be surprised and to see our predictions come to naught. But those predictions themselves, with their warning voice, can have a vital share in provoking and informing the spontaneity that is going to confound them.

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[1]But as serious an actuality as the Chinese plough "wandered" slowly westward with little traces of its route and finally caused a major, highly beneficial revolution in medieval European agriculture, which almost no one deemed worth recording when it happened (cf. Paul Leser, *Entstehung und Verbreitung des Pfluges*, Münster, 1931; reprint: The International Secretariate for Research on the History of Agricultural Implements, Brede-Lingby, Denmark, 1971).

[2]I here loosely refer to Adolph Lowe, "The Normative Roots of Economic Values," in Sidney Hook, ed., *Human Values and Economic Policy* (New York: New York University Press, 1967) and, more perhaps, to the many discussions I had with Lowe over the years. For my side of the argument, see "Economic Knowledge and the Critique of Goals," in R. L. Heilbroner, ed., *Economic Means and Social Ends* (Englewood Cliffs, N.J.: Prentice-Hall, 1969), reprinted in Hans Jonas, *Philosophical Essays* (Englewood Cliffs, N.J.: Prentice-Hall, 1969), reprinted in Hans Jonas, *Philosophical Essays* (Englewood Cliffs, N.J.: Prentice-Hall, 1974).

[3]"The Practical Uses of Theory," *Social Research* 26 (1959), reprinted in Hans Jonas, *The Phenomenon of Life* (New York, 1966). The reference is to pp. 209-10 in the latter edition.

[1]"Philosophical Reflections on Experimenting with Human Subjects," in Paul A. Freund, ed., *Experimentation with Human Subjects* (New York: George Braziller, 1970), reprinted in Hans Jonas, *Philosophical Essays*. The reference is to pp. 124-25 in the latter edition.

[2]For a comprehensive view of the demands which such a situation or even its approach would make on our social and political values, see Geoffrey Vickers, *Freedom in a Rocking Boat* (London, 1970).

The technological order

JACQUES ELLUL

■ Jacques Ellul *was born in 1912 in Bordeaux. He is a historian and a theological philosopher whose book* The Technological Society, *published in France in 1954, anticipated the contemporary antitechnological movement. Currently he holds the chair of the history of law, in the faculty of law at the University of Bordeaux. He is also a professor of social history at the Bordeaux Institute of Political Studies. Among his other books are* The Ethics of Freedom *and* Propaganda.

In this article Ellul introduces his famous thesis, namely that technique is autonomous, that is, self-determined. To emphasize the power of technique in our society, he argues that it does not influence *all social phenomena. Rather, these are* "situated in" *technique and are* "defined" *through their relation to the technological society. It is clear from Ellul's discussion that "Technique" refers to more than simply machine-related functions; it comprises organizational as well as psycho-sociological techniques. The psycho-sociological techniques "result in the* modification *of men in order to render them happily subordinate to their new environment." It is interesting to evaluate this last assertion in light of Fromm's description of individuals in a technological society as "powerless, lonely and anxious" (see the selection by Fromm later in Part Two).*

Ellul addresses himself to two questions: "Is man able to remain master in a world of means? Can a new civilization appear inclusive of Technique?" His answer to both is "no." In the ensuing discussion he concludes that "there is no possibility of turning back, annulling, or even of arresting technical progress." We are left with an impression of technological determinism. For a discussion of Ellul's position, see the article by Robert Theobald in Part Three.

I. I refer the reader to my book *La Technique* for an account of my general theses on this subject. I shall confine myself here to recapitulating the points which seem to me to be essential to a sociological study of the problem:

1. Technique[1] has become the new and specific *milieu* in which man is required to exist, one which has supplanted the old *milieu*, viz., that of nature.

2. This new technical *milieu* has the following characteristics:

a. It is artificial;
b. It is autonomous with respect to values, ideas, and the state;
c. It is self-determining in a closed circle. Like nature, it is a closed organization which permits it to be self-determinative independently of all human intervention;
d. It grows according to a process which is causal but not directed to ends;
e. It is formed by an accumulation of means which have established primacy over ends;
f. All its parts are mutually implicated to such a degree that it is impossible to separate them or to settle any technical problem in isolation.

3. The development of the individual techniques is an "ambivalent" phenomenon.

4. Since Technique has become the new *milieu*, all social phenomena are situated in it. It is incorrect to say that economics, politics, and the sphere of the cultural are influenced or modified *by* Technique; they are rather situated *in* it, a novel situation modifying all traditional social concepts. Politics, for example, is not modified by Technique as one factor among others which operate upon it; the political world is today *defined* through its relation to the technological society. Traditionally, politics formed a part of a larger social whole; at the present the converse is the case.

5. Technique comprises organizational and psycho-sociological techniques. It is useless to hope that the use of techniques of organization will succeed in compensating for the effects of

□ Jacques Ellul, "The Technological Order," trans. John Wilkinson. Reprinted from *The Technological Order*, ed. Carl E. Stover (Detroit: Wayne State University Press, 1963), pp. 10-24, by permission of the Wayne State University Press and the author.

techniques in general; or that the use of psycho-sociological techniques will assure mankind ascendancy over the technical phenomenon. In the former case, we will doubtless succeed in averting certain technically induced crises, disorders, and serious social disequilibrations; but this will but confirm the fact that Technique constitutes a closed circle. In the latter case, we will secure human psychic equilibrium in the technological *milieu* by avoiding the psycho-biologic pathology resulting from the individual techniques taken singly and thereby attain a certain happiness. But these results will come about through the *adaptation of human beings to the technical milieu*. Psycho-sociological techniques result in the *modification* of men in order to render them happily subordinate to their new environment, and by no means imply any kind of human domination over Technique.

6. The ideas, judgments, beliefs, and myths of the man of today have already been essentially modified by his technical *milieu*. It is no longer possible to reflect that on the one hand, there are techniques which may or may not have an effect on the human being; and, on the other, there is the human being himself who is to attempt to invent means to master his techniques and subordinate them to his own ends by *making a choice* among them. Choices and ends are both based on beliefs, sociological presuppositions, and myths which are a function of the technological society. Modern man's state of mind is completely dominated by technical values, and his goals are represented only by such progress and happiness as is to be achieved through techniques. Modern man in choosing is already incorporated within the technical process and modified in his nature by it. He is no longer in his traditional state of freedom with respect to judgment and choice.

II. To understand the problem posed to us, it is first of all requisite to disembarrass ourselves of certain fake problems.

1. We make too much of the disagreeable features of technical development, for example, urban over-crowding, nervous tension, air pollution, and so forth. I am convinced that all such inconveniences will be done away with by the ongoing evolution of Technique itself, and indeed, that it is only by means of such evolution that this can happen. The inconveniences we emphasize are always dependent on technical solutions, and it is only by means of techniques that they can be solved. This fact leads to the following two considerations:

a. Every solution to some technical inconvenience is able only to reinforce the system of techniques *in their ensemble;*

b. Enmeshed in a process of technical development like our own, the possibilities of human survival are better served by more technique than less, a fact which contributes nothing, however, to the resolution of the basic problem.

2. We hear too often that morals are being threatened by the growth of our techniques. For example, we hear of greater moral decadence in those environments most directly affected technically, say, in working class or urbanized *milieux*. We hear, too, of familial disintegration as a function of techniques. The falseness of this problem consists in contrasting the technological environment with the moral values inculcated by society itself.[2] The presumed opposition between ethical problematics and technological systematics probably at the present is, and certainly in the long run will be, false. The traditional ethical *milieu* and the traditional moral values are admittedly in process of disappearing, and we are witnessing the creation of a *new* technological ethics with its own values. We are witnessing the evolution of a morally consistent system of imperatives and virtues, which tends to replace the traditional system. But man is not necessarily left thereby on a morally inferior level, although a moral relativism is indeed implied—an attitude according to which everything is well, *provided* that the individual obeys some ethic or other. We *could* contest the value of this development *if* we had a clear and adequate concept of what good-in-itself is. But such judgments are impossible on the basis of our general morality. On *that* level, what we are getting is merely a substitution of a new technological morality for a traditional one which Technique has rendered obsolete.

3. We dread the "sterilization" of art through technique. We hear the artist's lack of freedom, calm, and the impossibility of meditation in the technological society. This problem is no more real than the two preceeding. On the contrary, the best artistic production of the present is a result of a close connection between art and Technique. Naturally, new artistic form, expression, and ethic are implied, but this fact does not make art less art than what we traditionally called such. What assuredly is *not* art is a fixation in congealed forms, and a rejection of technical evolution as exemplified, say, in the

neo-classicism of the nineteenth century or in present day "socialist realism." The modern cinema furnishes an artistic response comparable to the Greek theater at its best; and modern music, painting, and poetry express, not a canker, but an authentic esthetic expression of mankind plunged into a new technical *milieu*.

4. One last example of a false problem is our fear that the technological society is completely *eliminating* instinctive human values and powers. It is held that systematization, organization, "rationalized" conditions of labor, overly hygienic living conditions, and the like have a tendency to repress the forces of instinct. For some people the phenomenon of "beatniks," "*blousons noirs*,"[3] and "hooligans" is explained by youth's violent reaction and the protestation of youth's vital force to a society which is overorganized, overordered, overregulated, in short, technicized.[4] But here too, even if the facts are established beyond question, it is very likely that a superior conception of the technological society will result in the integration of these instinctive, creative, and vital forces. Compensatory mechanisms are already coming into play; the increasing appreciation of the aesthetic eroticism of authors like Henry Miller and the rehabilitation of the Marquis de Sade are good examples. The same holds for music like the new jazz forms which are "escapist" and exaltative of instinct; *item*, the latest dances. All these things represent a process of "*défoulement*"[5] which is finding its place in the technological society. In the same way, we are beginning to understand that it is impossible indefinitely to repress or expel religious tendencies and to bring the human race to a perfect rationality. Our fears for our instincts *are* justified to the degree that Technique, instead of provoking conflict, tends rather to *absorb* it, and to *integrate* instinctive and religious forces by giving them a place within its structure, whether it be by an adaptation of Christianity[6] or by the creation of new religious expressions like myths and mystiques which are in full compatibility with the technological society.[7] The Russians have gone farthest in creating a "religion" compatible with Technique by means of their transformation of Communism into a religion.

III. What, then, is the real problem posed to men by the development of the technological society? It comprises two parts: 1. Is man able to remain master[8] in a world of means? 2. Can a new civilization appear inclusive of Technique?

1. The answer to the first question, and the one most often encountered, seem obvious: Man, who exploits the ensemble of means, *is* the master of them. Unfortunately, this manner of viewing matters is purely theoretical and superficial. We must remember the autonomous character of Technique. We must likewise not lose sight of the fact that the human individual himself is to be an ever greater degree the *object* of certain techniques and their procedures. He is the object of pedagogical techniques, psychotechniques, vocational guidance testing, personality and intelligence testing, industrial and group aptitude testing, and so on. In these cases (and in countless others) most men are treated as a collection of objects. But, it might be objected, these techniques are exploited by other men, and the exploiters at least remain masters. In a certain sense this is true; the exploiters *are* masters of the particular techniques they exploit. But, they, too, are subjected to the action of yet other techniques, as, for example, propaganda. Above all, they are spiritually taken over by the technological society; they believe in what they do; they are the most fervent adepts of that society. They themselves have been profoundly technicized. They never in any way affect to despise Technique, which to them is a thing good in itself. They never pretend to assign values to Technique, which to them is in itself an entity working out its own ends. They never claim to subordinate it to any value because for them Technique *is* value.

It may be objected that these individual techniques have as their end the best adaptation of the individual, the best utilization of his abilities, and, in the long run, his happiness. This, in effect, is the objective and the justification of all techniques. (One ought not, of course, to confound man's "happiness" with capacity for mastery with, say, freedom.) If the first of all values is happiness, it is likely that man, thanks to his techniques, will be in a position to attain to a certain state of this good. But happiness does not contain everything it is thought to contain, and *the absolute disparity between happiness and freedom* remains an ever real theme for our reflections. To say that man should remain *subject* rather than *object* in the technological society means two things, viz., that he be capable of giving direction and orientation to Technique, and that, to this end, he be able to master it.

Up to the present he has been able to do neither. As to the first, he is content passively to participate in technical progress, to accept whatever direction it takes automatically, and to admit its autonomous meaning. In the circumstances he can either proclaim this life is an absurdity without meaning or value; *or*, he can predicate a number of indefinitely sophisticated values. But neither attitude accords with the fact of the technical phenomenon any more than it does with the other. Modern declarations of the absurdity of life are not based on modern technological efflorescence, which none (least of all the existentialists) think an absurdity. And the predication of values is a purely theoretical matter, since these values are not equipped with any means for putting them into practice. It is easy to reach agreement on what they are, but it is quite another matter to make them have any effect whatever on the technological society, or to cause them to be accepted in such a way that techniques must evolve in order to realize them. The values spoken of in the technological society are simply there to justify what is; *or*, they are generalities without consequence; *or* technical progress realizes them automatically as a matter of course. Put otherwise, neither of the above alternatives is to be taken seriously.

The second condition *that man be subject rather than object*, i.e., the imperative that he exercise mastery over technical development, is facilely accepted by everyone. But factually it simply does not hold. Even more embarrassing than the question "How?" is the question "Who?" We must ask ourselves realistically and concretely just who is in a position to choose the values which give Technique its justification and to exert mastery over it. If such a person or persons are to be found, it must be in the Western world (inclusive of Russia). They certainly are not to be discovered in the bulk of the world's population which inhabits Africa and Asia, who are, as yet, scarcely confronted by technical problems, and who, in any case, are even less aware of the questions involved than we are.

Is the arbiter we seek to be found among the *philosophers*, those thinking specialists? We well know the small influence these gentry exert upon our society, and how the technicians of every order distrust them and rightly refuse to take their reveries seriously. Even if the philosopher could make his voice heard, he would still have to contrive means of mass education so as to communicate an effective message to the masses.

Can the *technician* himself assume mastery over Technique? The trouble here is that the technician is *always* a specialist and cannot make the slightest claim to have mastered any technique but his own. Those for whom Technique bears its meaning in itself will scarcely discover the values which lend meaning to what they are doing. They will not even look for them. The only thing they can do is to apply their technical specialty and assist in its refinement. They cannot *in principle* dominate the totality of the technical problem or envisage it in its global dimensions. *Ergo*, they are completely incapable of mastering it.

Can the *scientist* do it? There, if anywhere, is the great hope. Does not the scientist dominate our techniques? Is he not an intellectual inclined and fit to put basic questions? Unfortunately, we are obliged to re-examine our hopes here when we look at things as they are. We see quickly enough that the scientist is as specialized as the technician, as incapable of general ideas, and as much out of commission as the philosopher. Think of the scientists who, on one tack or another, have addressed themselves to the technical phenomenon: Einstein, Oppenheimer, Carrel. It is only too clear that the ideas these gentlemen have advanced in the sphere of the philosophic or the spirtual are vague, superficial, and contradictory *in extremis*. They really ought to stick to warnings and proclamations, for as soon as they assay anything else, the other scientists and the technicians rightly refuse to take them seriously, and they even run the risk of losing their reputations as scientists.

Can the *politician* bring it off? In the democracies the politicians are subject to the wishes of their constituents who are primarily concerned with the happiness and well-being which they think Technique assures them. Moreover, the further we get on, the more a conflict shapes up between the politicians and the technicians. We cannot here go into the matter which is just beginning to be the object of serious study.[9] But it would appear that the power of the politician is being (and will continue to be) outclassed by the power of the technician in modern states. Only dictatorships can impose their will on technical evolution. But, on the one hand, human freedom would gain nothing thereby, and, on the other, a dictatorship thirsty for power has no recourse at all but to push toward an excessive development of various techniques at its disposal.

Any of us? An individual can doubtless seek the soundest attitude to dominate the techniques at his disposal. He can inquire after the values to impose on techniques in his use of them, and search out the way to follow in order to remain a man in the fullest sense of the word within a technological society. All this is extremely difficult, but it is far from being useless, since it is apparently the only solution presently possible. But the individual's efforts are powerless to resolve in any way the technical problem in its universality; to accomplish this would mean that *all* men adopt the same values and the same behavior.

2. The second real problem posed by the technological society is whether or not a new civilization can appear which is inclusive of Technique. The elements of this question are as difficult as those of the first. It would obviously be vain to deny all the things that can contribute something useful to a new civilization: security, ease of living, social solidarity, shortening of the work week, social security, and so forth. But a civilization in the strictest sense of the term is not brought into being by all these things.

A threefold contradiction resides between civilization and Technique of which we must be aware if we are to approach the problem correctly:

a. The technical world is the world of material things; it is put together out of material things and with respect to them. When Technique displays any interest in man, it does so by converting him into a material object. The supreme and final authority in the technological society is fact, at once ground and evidence. And when we think on man as he exists in this society it can only be as a being immersed in a universe of objects, machines, and innumerable material things. Technique indeed guarantees him such material happiness as material objects can. But, the technical society is not, and cannot be, a genuinely humanist society since it puts in first place not man but material things. It can only act on man by lessening him and putting him in the way of the quantitative. The radical contradiction referred to exists between technical perfection and human development because such perfection is only to be achieved through quantitative development and necessarily aims exclusively at what is measurable. Human excellence, on the contrary, is of the domain of the qualitative and aims at what is not measurable. Space is lacking here to argue the point that spiritual values cannot evolve as a function of material improvement. The transition from the technically quantitative to the humanly qualitative is an impossible one. In our times, technical growth monopolizes all human forces, passions, intelligences, and virtues in such a way that it is in practice nigh impossible to seek and find anywhere any distinctively human excellence. And if this search is impossible, there cannot be any civilization in the proper sense of the term.

b. Technical growth leads to a growth of power in the sense of technical means incomparably more effective than anything ever before invented, power which has as its object only power, in the widest sense of the word. The possibility of action becomes limitless and absolute. For example, we are confronted for the first time with the possibility of the annihilation of all life on earth, since we have the means to accomplish it. In *every* sphere of action we are faced with just such absolute possibilities. Again, by way of example, governmental techniques, which amalgamate organizational, psychological, and police techniques, tend to lend to government absolute powers. And here I must emphasize a great law which I believe to be essential to the comprehension of the world in which we live, viz., that when power becomes absolute, values disappear. When man is able to accomplish anything at all, there is no value which can be proposed to him; when the means of action are absolute, no goal of action is imaginable. Power eliminates, in proportion to its growth, the boundary between good and evil, between the just and the unjust. We are familiar enough with this phenomenon in totalitarian societies. The distinction between good and evil disappears beginning with the moment that the ground of action (for example the *raison d'état*, or the instinct of the proletariat) claims to have absolute power and thus to incorporate *ipso facto* all value. Thus it is that the growth of technical means tending to absolutism forbids the appearance of values, and condemns to sterility our search for the ethical and the spiritual. Again, where Technique has place, there is the implication of the impossibility of the evolution of civilization.

c. The third and final contradiction is that Technique can never engender freedom. Of course, Technique frees mankind from a whole collection of ancient constraints. It is evident, for example, that it liberates him from the limits imposed on him by time and space; that man, through its agency, is free (or at least tending to become free) from famine, excessive heat and cold, the rhythms of the seasons, and from the gloom of night; that the race is freed from certain social constraints through its commerce with the universe, and from its intellectual limitations through its accumulation of information. But is this what it means really to be free? Other constraints as oppressive and rigorous as the traditional ones are imposed on the human being in today's technological society through the agency of Technique. New limits and technical oppressions have taken the place of the older, natural constraints, and we certainly cannot aver that much has been gained. The problem is deeper—the operation of Technique is the contrary of freedom, an operation of determinism and necessity. Technique is an ensemble of rational and efficient practices; a collection of orders, schemas, and mechanisms. All of this expresses very well a necessary order and a determinate process, but one into which freedom, unorthodoxy, and the sphere of the gratuitous and spontaneous cannot penetrate. All that these last could possibly introduce is discord and disorder. The more technical actions increase in society, the more human autonomy and initiative diminish. The more the human being comes to exist in a world of ever increasing demands (fortified with technical apparatus possessing its own laws to meet these demands), the more he loses any possibility of free choice and individuality in action. This loss is greatly magnified by Technique's character of self-determination, which makes its appearance among us as a kind of fatality and as a species of perpetually exaggerated necessity. But where freedom is excluded in this way, an authentic civilization has little chance. Confronted in this way by the problem, it is clear to us that no solution can exist, in spite of the writings of all the authors who have concerned themselves with it. They all make an unacceptable premise, viz., rejection of Technique and return to a pre-technical society. One may well regret that some value or other of the past, some social or moral form, has disappeared; but, when one attacks the problem of the technical society, one can scarcely make the serious claim to be able to revive the past, a procedure which, in any case, scarcely seems to have been, globally speaking, much of an improvement over the human situation of today. All we know with certainty is that it was different, that the human being confronted other dangers, errors, difficulties, and temptations. Our duty is to occupy ourselves with the dangers, errors, difficulties, and temptations of modern man in the modern world. All regret for the past is vain; every desire to revert to a former social stage is unreal. There is no possibility of turning back, of annulling, or even of arresting technical progress. What is done is done. It is our duty to find our place in our present situation and in no other. Nostalgia has no survival value in the modern world and can only be considered a flight into dreamland.

We shall insist no further on this point. Beyond it, we can divide into two great categories the authors who search for a solution to the problem posed by Technique: The first class is that of those who hold that the problem will solve itself; the second, of those who hold that the problem demands a great effort or even a great modification of the whole man. We shall indicate a number of examples drawn from each class and beg to be excused for choosing to cite principally French authors.

Politicians, scientists and technicians are to be found in the first class. In general, they consider the problem in a very concrete and practical way. Their general notion seems to be that technical progress resolves all difficulties *pari passu* with their appearance, and that it contains within itself the solution to everything. The sufficient condition for them, therefore, is that technical progress be not arrested; everything which plagues us today will disappear tomorrow.

The primary example of these people is furnished by the Marxists, for whom technical progress is the solution to the plight of the proletariat and all its miseries, and to the problem posed by the exploitation of man by man in the capitalistic world. Technical progress, which is for Marx the motive force of history, *necessarily* increases the forces of production, and simultaneously produces a progressive conflict between forward moving factors and stationary social factors like the state, law, ideology, and morality, a conflict occasioning the periodic disappearance of the outmoded factors. Specifically, in the world of the present, conflict necessitates the disappearance of the structures of capitalism, which are so constituted as to be completely unable to absorb the economic results of technical progress, and are hence obliged to vanish. When they do vanish, they of necessity make room for a socialist structure of society corresponding perfectly to the sound and normal utilization of Technique. The Marxist solution to the technical problems is therefore an automatic one since the transition to socialism is *in itself* the solution. Everything is *ex hypothesi* resolved in the socialist society, and humankind finds therein its maturation. Technique, integrated into the socialist society "changes sign": from being destructive it becomes constructive; from being a means of human exploitation it becomes humane; the contradiction between the infrastructures and the suprastructures disappears. In other words, all the admittedly difficult problems raised in the modern world belong to the structure of capitalism and not to that of Technique. On the one hand, it *suffices* that social structures become socialist for social problems to disappear; and on the other, society *must necessarily* become socialist by the very movement of Technique. Technique, therefore, carries in itself the response to all the difficulties it raises.

A second example of this kind of solution is given by a certain number of technicians, for example, Frisch. All difficulties, according to Frisch, will inevitably be resolved by the technical growth which will bring the technicians to power. Technique admittedly raises certain conflicts and problems, but their cause is that the human race remains attached to certain political ideologies and moralities and loyal to certain outmoded and antiquated humanists whose sole visible function is to provoke discord of heart and head, thereby preventing men from adapting themselves and from entering resolutely into the path of technical progress. *Ergo*, men are subject to distortions of life and consciousness which have their origin, *not* in Technique, but in the conflict between Technique and the false values to which men remain attached. These fake values, decrepit sentiments, and outmoded notions must inevitably be eliminated by the invincible progress of Technique. In particular, in the political domain, the majority of crises arise from the fact that men are still wedded to certain antique political forms and ideas, for example, democracy. All problems will be resolved if power is delivered into the hands of the technicians who alone are capable of directing Technique in its entirety and making of it a positive instrument for human service. This is all the more true in that, thanks to the so-called "human techniques" (for example, propaganda) they will be in a position to take account of the human factor in the technical context. The technocrats will be able to use the totality of Technique without destroying the human being, but rather by treating him as he should be treated so as to become simultaneously useful and happy. General power accorded to the technicians become technocrats is the only way out for Frisch, since they are the only ones possessing the necessary competence; and, in any case, they are being carried to power by the current of history, the fact which alone offers a quick enough solution to technical problems. It is impossible to rely on the general improvement of the human species, a process which would take too long and would be too chancy. For the generality of men, it is necessary to take into account that Technique establishes an inevitable discipline, which, on the one hand, they must accept, and, on the other, the technocrats will humanize.

The third and last example (it is possible that there are many more) is furnished by the economists, who, in very different ways, affirm the thesis of the automatic solution. Fourastié is a good example of such economists. For him, the first thing to do is to draw up a balance between that which Technique is able to deliver and that which it may destroy. In his eyes there is no real problem: What Technique can bring to man is incomparably superior to that which it threatens. Moreover, if difficulties *do* exist, they are only temporary ones which will be resolved beneficially, as was the case with the similar difficulties of the last century. Nothing decisive is at stake; man is in no mortal danger. The contrary is the case: Technique produces the foundation, infrastructure, and suprastructure which will enable man really to become man. What we have known up to now can only be called the *prehistory* of a human race so overwhelmed by material cares, famine, and danger, that the truly human never had an opportunity to develop into a civilization worthy of the name. Human intellectual, spiritual, and moral life will, according to Fourastié, never mature except when life is able to start from a complete satisfaction of its material needs, complete security, including security from famine and disease. The growth of Technique, therefore, initiates the genuinely human history of the whole man. This new type of human being will clearly be different from what we have hitherto known; but this fact should occasion no complaint or fear. The new type cannot help being superior to the old in every way, *after* all the traditional (and exclusively material) obstacles to his development have vanished. Thus, progress occurs automatically, and the inevitable role of Technique will be that of guaranteeing such material development as allows the intellectual and spiritual maturation of what has been up to now only potentially present in human nature.

The orientation of the other group of doctrines affirms, on the contrary, that man is dangerously imperiled by technical progress; and that human will, personality, and organization must be set again to rights if society is to be able to guard against the imminent danger. Unfortunately, these doctrines share with their opposites the quality of being too optimistic, in that they affirm that their thesis is even feasible and that man is really capable of the rectifications proposed. I will give three very different examples of this, noting that the attitude in question is generally due to philosophers and theologians.

The orientation of Einstein, and the closely related one of Jules Romains, are well known, viz., that the human being must get technical progress back again into his own hands, admitting that the situation is so complicated and the data so overwhelming that only some kind of "superstate" can possibly accomplish the task. A sort of spiritual power integrated into a world government in possession of indisputable moral authority might be able to master the progression of techniques and to direct human evolution. Einstein's suggestion is the convocation of certain philosopher-scientists, whereas Romains' idea is the establishment of a "Supreme Court of Humanity." Both of these bodies would be organs of meditation, of moral quest, before which temporal powers would be forced to bow. (One thinks, in this connection, of the role of the papacy in medieval Christianity *vis-à-vis* the temporal powers.)

A second example of this kind of orientation is given by Bergson, at the end of his work, *The Two Sources of Morality and Religion*. According to Bergson, initiative can only proceed from humanity, since in Technique there is no "*force des choses*." Technique has conferred disproportionate power on the human being, and a disproportionate extension to his organism. But, "in this disproportionately magnified body, the soul remains what it was, i.e., too small to fill it and too feeble to direct it. Hence the void between the two." Bergson goes on to say that "this enlarged body awaits a supplement of soul, the mechanical demands the mystical," and . . . "that Technique will never render service proportionate to its powers unless humanity, which has bent it earthwards, succeeds by its means in reforming itself and looking heavenwards." This means that humanity has a task to perform, and that man must grow proportionately to his techniques, but that he must *will* it and *force* himself to make the experiment. This experiment is, in Bergson's view, a possibility, and is even favored by that technical growth which allows more material resources to men than ever before. The required "supplement of soul" is therefore of the order of the possible and will suffice for humans to establish mastery over Technique. The same position, it may be added, has in great part been picked up by E. Mounier.

A third example is afforded by a whole group of theologians, most of them Roman Catholic. Man, in his actions in the domain of the technical, is but obeying the vocation assigned him by his Creator. Man, in continuing his work of technical creation, is pursuing the work of his Creator. Thanks to Technique, this man, who was originally created "insufficient," is becoming "adolescent." He is summoned to new responsibilities in this world which do not transcend his powers since they correspond exactly to what God expects of him. Moreover, it is God Himself who through man is the Creator of Technique, which is something not to be taken in itself but in its relation to its Creator. Under such conditions, it is clear that Technique is neither evil nor fraught with evil consequences. On the contrary, it is good and cannot be dangerous to men. It can only become evil to the extent that man turns from God; it is a danger only if its true nature is misapprehended. All the errors and problems visible in today's world result uniquely from the fact that man no longer recognizes his vocation as God's collaborator. If man ceases to adore the "creature" (i.e., Technique) in order to adore the true God; if he turns Technique to God and to His service, the problems must disappear. All of this is considered the more true in that the world transformed by technical activity *must* become the point of departure and the material support of the new creation which is to come at the end of time.

Finally, it is necessary to represent by itself a doctrine which holds at the present a place of some importance in the Western world, i.e., that of Father Teilhard de Chardin, a man who was simultaneously a theologian and a scientist. His doctrine appears as an intermediate between the two tendencies already sketched. For Chardin, evolution in general, since the origin of the universe, has represented a constant progression. First of all, there was a motion toward a diversification of matter and of beings; then, there supervened a motion toward Unity, i.e., a higher Unity. In the biological world, every step forward has been effected when man has passed from a stage of "dispersion" to a stage of "concentration." At the present, technical human progress and the spontaneous movement of life are in agreement and in mutual continuity. They are evolving together toward a higher degree of organization, and this movement manifests the influence of Spirit. Matter, left to itself, is characterized by a necessary and continuous degradation. But on the contrary, we note that progress, advancement, improvement do exist, and, hence, a power contradicting the spontaneous movement of matter, a power of creation and progress exists which is the opposite of matter, i.e., it is Spirit. Spirit has contrived Technique as a means of organizing dispersed matter, in order simultaneously to express progress and to combat the degradation of matter. Technique is producing at the same time a prodigious demographic explosion, i.e., a greater density of human population. By all these means it is bringing forth "communion" among men; and likewise creating from inanimate matter a higher and more organized form of matter which is taking part in the ascension of the cosmos toward God. Granting that it is true that every progression in the physical and biological order is brought about by a condensation of the elements of the preceeding period, what we are witnessing today, according to Chardin, is a condensation, a concentration of the whole human species. Technique, in producing this, possesses a function of unification *inside* humanity, so that humanity becomes able thereby to have access to a sort of unity. Technical progress is therefore synonymous with "socialization," this latter being but the political and economic sign of communion among men, the temporary expression of the "condensation" of the human species into a whole. Technique is the irreversible agent of this condensation; it prepares the new step forward which humanity must make. When men cease to be individual and separate units, and all together form a total and indissoluble communion, then humanity will be a single body. This material concentration is always accompanied by a spiritual, i.e., a maturation of the spirit, the commencement of a new species of life. Thanks to Technique, there is "socialization," the progressive concentration on a planetary scale of disseminated spiritual personalities into a suprapersonal unity. This mutation leads to another Man, spiritual and unique, and means that humanity in its ensemble and in its unity, has attained the supreme goal, i.e., its fusion with that glorious Christ who must appear at the end of time. Thus Chardin holds that in technical progress man is "Christified," and that technical evolution tends inevitably to the "edification" of the cosmic Christ.

It is clear that in Chardin's grandiose perspective, the individual problems, difficulties, and mishaps of Technique are negligible. It is likewise clear how Chardin's doctrine lies midway between the two preceding ones: On the one hand, it affirms a natural and involuntary ascension of man, a process inclusive of biology, history, and the like, evolving as a kind of will of God in which Technique has its proper place; and, on the other, it affirms that the evolution in question implies consciousness, and an intense *involvement* on the part of man who is proceeding to socialization and thus *commiting* himself to this mutation.

We shall not proceed to a critique of these different theories, but content ourselves with noting that all of them appear to repose on a too superficial view of the technical phenomenon; and that they are *practically* inapplicable because they presuppose a certain number of *necessary* conditions which are not given. None of these theories, therefore, can be deemed satisfactory.

NOTES

[1]In his book *La Technique*, Jacques Ellul states he is "in substantial agreement" with H. D. Lasswell's definition of technique: "the ensemble of practices by which one uses available resources in order to achieve certain valued ends." Commenting on Lasswell's definition, Ellul says: "In the examples which Lasswell gives, one discovers that he conceives the terms of his definition in an extremely wide manner. He gives a list of values and the corresponding techniques. For example, he indicates as values riches, power, well-being, affection, and so on, with the techniques of government, production, medicine, the family. This notion of value may seem somewhat novel. The expression is manifestly improper. But this indicates that Lasswell gives to techniques their full scope. Besides, he makes it quite clear that it is necessary to bring into the account not only the ways in which one influences things, but also the ways one influences persons." "Technique" as it is used by Ellul is most nearly equivalent to what we commonly think of as "the technological order" or "the technological society." (Trans.)

[2]Cf. K. Horney.

[3]A kind of French beatnik. (Trans.)

[4]The psychoanalyst Jung has much to say along this line.

[5]An untranslatable French play on words. *Défoulement* is an invented word which presumably expresses the opposite of *refoulement*, i.e., repression.

[6]Teilhard de Chardin represents, in his works, the best example of this.

[7]Examples of such myths are: "Happiness," "Progress," "The Golden Age," etc.

[8]French *sujet*. The usual rendering, "subject," would indicate exactly the contrary of what is meant here, viz., the opposite of "object." The present sense of "subject" is that in virtue of which it governs a grammatical object, for example. (Trans.)

[9]See, for example, the reports of the International Congress for Political Science, October, 1961.

Man the technician

JOSÉ ORTEGA Y GASSET

■ José Ortega y Gasset *(1883-1955) was a Spanish essayist and philosopher. He was born in Madrid of a patrician family. He taught at the University of Madrid, and was also active as a journalist and a politician. He is known for his analysis of history and modern culture, and especially for his penetrating study of the uniquely modern phenomenon "mass man." His book* The Revolt of the Masses *brought him international recognition. His philosophical views culminated over the years in an existentialist position which regarded the main vocation of the self to be self-realization. He held that the human being is decisively free in his inner self and that man is his history.*

For Ortega man is not an animal with a technological gift. Man is, in his very being, "self-made and autofabricated." Thus fabrication shapes the being of man. The world surrounds man with a web of facilities and difficulties, so that his existence in the world is "an unending struggle to accomodate himself in it." It is through this struggle that man at once defines his being and fabricates it. The origins of technology thus are embedded deep within man's being and his situation in the world. The "formidable and unparalleled character which makes man unique in the universe" is that he is "an entity whose being consists in not yet being," that is, an entity which is defined by its choices of what is not *yet. But these very choices that define man's being are crucial elements in the process of autofabrication. For this reason man is his history.*

EXCURSION TO THE SUBSTRUCTURE OF TECHNOLOGY

The answers which have been given to the question, what is technology, are appallingly superficial; and what is worse, this cannot be blamed on chance. For the same happens to all questions dealing with what is truly human in human beings. There is no way of throwing light upon them until they are tackled in those profound strata from which everything properly human evolves. As long as we continue to speak of the problems that concern man as though we knew what man really is, we shall only succeed in invariably leaving the true issue behind. That is what happens with technology. We must realize into what fundamental depths our argument will lead us. How does it come to pass that there exists in the universe this strange thing called technology, the absolute cosmic fact of man the technician? If we seriously intend to find an answer, we must be ready to plunge into certain unavoidable profundities.

We shall then come upon the fact that an entity in the universe, man, has no other way of existing than by being in another entity, nature or the world. This relation of being one in the other, man in nature, might take on one of three possible aspects. Nature might offer man nothing but facilities for his existence in it. That would mean that the being of man coincides fully with that of nature or, what is the same, that man is a natural being. That is the case of the stone, the plant, and, probably, the animal. If it were that of man, too, he would be without necessities, he would lack nothing, he would not be needy. His desires and their satisfaction would be one and the same. He would wish for nothing that did not exist in the world and, conversely, whatever he wished for would be there of itself, as in the fairy tale of the magic wand. Such an entity could not experience the world as something alien to himself; for the world would offer him no resistance. He would be in the world as though he were in himself.

Or the opposite might happen. The world might offer to man nothing but difficulties, i.e., the being of the world and the being of man might be completely antagonistic. In this case the world would be no abode for man; he could not exist in it, not even for the fraction of a second. There would be no human life and, consequently, no technology.

The third possibility is the one that prevails in reality. Living in the world, man finds that the world surrounds him as an intricate net woven of both facilities and difficulties. Indeed, there are not many things in it which, potentially, are not both. The earth supports him, enabling him to lie down when he is tired and to run when he has to flee. A shipwreck will bring home to him the advantage of the firm earth—a thing grown humble from habitude. But the earth also means distance. Much earth may separate him from the spring when he is thirsty. Or the earth may tower above him as a steep slope

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that is hard to climb. This fundamental phenomenon—perhaps the most fundamental of all—that we are surrounded by both facilities and difficulties gives to the reality called human life its peculiar ontological character.

For if man encountered no facilities it would be impossible for him to be in the world, he would not exist, and there would be no problem. Since he finds facilities to rely on, his existence is possible. But this possibility, since he also finds difficulties, is continually challenged, disturbed, imperiled. Hence, man's existence is no passive being in the world; it is an unending struggle to accommodate himself in it. The stone is given its existence; it need not fight for being what it is—a stone in the field. Man has to be himself in spite of unfavorable circumstances; that means he has to make his own existence at every single moment. He is given the abstract possibility of existing, but not the reality. This he has to conquer hour after hour. Man must earn his life, not only economically but metaphysically.

And all this for what reason? Obviously—but this is repeating the same thing in other words—because man's being and nature's being do not fully coincide. Because man's being is made of such strange stuff as to be partly akin to nature and partly not, at once natural and extranatural, a kind of ontological centaur, half immersed in nature, half transcending it. Dante would have likened him to a boat drawn up on the beach with one end of its keel in the water and the other in the sand. What is natural in him is realized by itself; it presents no problem. That is precisely why man does not consider it his true being. His extranatural part, on the other hand, is not there from the outset and of itself; it is but an aspiration, a project of life. And this we feel to be our true being; we call it our personality, our self. Our extra- and antinatural portion, however, must not be interpreted in terms of any of the older spiritual philosophies. I am not interested now in the so-called spirit *(Geist)*, a pretty confused idea laden with speculative wizardry.

If the reader reflects a little upon the meaning of the entity he calls his life, he will find that it is the attempt to carry out a definite program or project of existence. And his self—each man's self—is nothing but this devised program. All we do we do in the service of this program. Thus man begins by being something that has no reality, neither corporeal nor spiritual; he is a project as such, something which is not yet but aspires to be. One may object that there can be no program without somebody having it, without an idea, a mind, a soul, or whatever it is called. I cannot discuss this thoroughly because it would mean embarking on a course of philosophy. But I will say this: although the project of being a great financier has to be conceived of in an idea, "being" the project is different from holding the idea. In fact, I find no difficulty in thinking this idea but I am very far from being this project.

Here we come upon the formidable and unparalleled character which makes man unique in the universe. We are dealing—and let the disquieting strangeness of the case be well noted—with an entity whose being consists not in what it is already, but in what it is not yet, a being that consists in not-yet-being. Everything else in the world is what it is. An entity whose mode of being consists in what it is already, whose potentiality coincides at once with his reality, we call a "thing." Things are given their being ready-made.

In this sense man is not a thing but an aspiration, the aspiration to be this or that. Each epoch, each nation, each individual varies in its own way the general human aspiration.

Now, I hope, all terms of the absolute phenomenon called "my life" will be clearly understood. Existence means, for each of us, the process of realizing, under given conditions, the aspiration we are. We cannot choose the world in which to live. We find ourselves, without our previous consent, embedded in an environment, a here and now. And my environment is made up not only by heaven and earth around me, but by my own body and my own soul. I am not my body; I find myself with it, and with it I must live, be it handsome or ugly, weak or sturdy. Neither am I my soul; I find myself with it and must use it for the purpose of living although it may lack will power or memory and not be of much good. Body and soul are things; but I am a drama, if anything, an unending struggle to be what I have to be. The aspiration or program I am, impresses its peculiar profile on the world about me, and that world reacts to this impress, accepting or resisting it. My aspiration meets with hindrance or with furtherance in my environment.

At this point one remark must be made which would have been misunderstood before. What we call nature, circumstance, or the world is essentially nothing but a conjunction of favorable and adverse conditions encountered by man in the pursuit of this program. The three names are interpretations of ours; what we first come upon is the experience of being hampered or favored in living. We are wont to conceive of nature and world as existing by themselves, independent of man. The concept "thing" likewise refers to something that has a hard and fast being and has it by itself and apart from man. But I repeat, this is the result of an interpretative reaction of our intellect upon what first confronts us. What first confronts us has no being apart from and independent of us; it consists exclusively in presenting facilities and difficulties, that is to say, in what it is in respect to our aspiration. Only in relation to our vital program is something an obstacle or an aid. And according to the aspiration animating us the facilities and difficulties, making up our pure and fundamental environment, will be such or such, greater or smaller.

This explains why to each epoch and even to each individual the world looks different. To the particular profile of our personal project, circumstance answers with another definite profile of facilities and difficulties. The world of the businessman obviously is different from the world of the poet. Where one comes to grief, the other thrives; where one rejoices, the other frets. The two worlds, no doubt, have many elements in common, viz., those which correspond to the generic aspiration of man as a species. But the human species is incomparably less stable and more mutable than any animal species. Men have an intractable way of being enormously unequal in spite of all assurances to the contrary.

LIFE AS AUTOFABRICATION—TECHNOLOGY AND DESIRES

From this point of view human life, the existence of man, appears essentially problematic. To all other entities of the universe existence presents no problem. For existence means actual realization of an essence. It means, for instance, that "being a bull" actually occurs. A bull, if he exists, exists as a bull. For a man, on the contrary, to exist does not mean to exist at once as the man he is, but merely that there exists a possibility of, and an effort towards, accomplishing this. Who of us is all he should be and all he longs to be? In contrast to the rest of creation, man, in existing, has to make his existence. He has to solve the practical problem of transferring into reality the program that is himself. For this reason "my life" is pure task, a thing inexorably to be made. It is not given to me as a present; I have to make it. Life gives me much to do; nay, it is nothing save the "to do" it has in store for me. And this "to do" is not a thing, but action in the most active sense of the word.

In the case of other beings the assumption is that somebody or something, already existing, acts; here we are dealing with an entity that has to act in order to be; its being presupposes action. Man, willy-nilly, is self-made, autofabricated. The word is not unfitting. It emphasizes the fact that in the very root of his essence man finds himself called upon to be an engineer. Life means to him at once and primarily the effort to bring into existence what does not exist offhand, to wit: himself. In short, human life "is" production. By this I mean to say that fundamentally life is not, as has been believed for so many centuries, contemplation, thinking, theory, but action. It is fabrication; and it is thinking, theory, science only because these are needed for its autofabrication, hence secondarily, not primarily. To live . . . that is to find means and ways for realizing the program we are.

The world, the environment, presents itself as *materia prima* and possible machine for this purpose. Since man, in order to exist, has to be in the world and the world does not admit forthwith of the full realization of his being, he sets out to search around for the hidden instrument that may serve his ends. The history of human thinking may be regarded as a long series of observations made to discover what latent possibilities the world offers for the construction of machines. And it is not by chance, as we shall shortly see, that technology properly speaking, technology in the fullness of its maturity, begins around 1600, when man in the course of his theoretical thinking about the world comes to regard it as a machine. Modern technology is linked with the work of Galileo, Descartes, Huygens, i.e., with the mechanical interpretation of the universe. Before that, the corporeal world had been generally believed to be an a-mechanical entity, the ultimate essence of which was constituted by spiritual powers of more or less arbitrary and uncontrollable nature; whereas the world as pure mechanism is the machine of machines.

It is, therefore, a fundamental error to believe that man is an animal endowed with a talent for technology, in other words, that an animal might be transmuted into a man by magically grafting on it the technical gift. The opposite holds: because man has to accomplish a task fundamentally different from that of the animal, an extranatural task, he cannot spend his energies in satisfying his elemental needs, but must stint them in this realm so as to be able to employ them freely in the odd pursuit of realizing his being in the world.

HISTORICAL

The *vita activa* and the modern age

The reversal within the *vita activa* and the victory of *homo faber*

HANNAH ARENDT

■ Hannah Arendt *(1906-1975) was born in Hannover and immigrated to the United States in 1941. She taught philosophy at several institutions, the last being the New School for Social Research, which she joined in 1967. She remained there until her death. She was an erudite and disciplined thinker who combined intuition with powerful reasoning. She was a critical investigator of political and philosophical developments throughout history. It was in the course of such investigations that she provided her own highly controversial interpretations of these developments. Among her works are* The Origins of Totalitarianism *(1951) and* The Human Condition *(1958), of which the following is an excerpt.*

In the section from which this passage is taken, Arendt discusses the historical shift in man's hierarchy of value. At one time the highest position in that hierarchy was occupied by contemplation. In modern times this is no longer true. Arendt attempts to explain that the significance of this change goes beyond mere replacement of contemplation by fabrication. After all, as Arendt points out "contemplation and fabrication . . . have an inner affinity." That affinity lies in the fact that "contemplation, the beholding of something, was considered to be an inherent element in fabrication as well, inasmuch as the work of the craftsman was guided by the "idea," the model beheld by him before the fabrication process had started as well as after it ended. She points out that the traditional sense of contemplation is rooted in the craftsman's recognition that the models of his fabrication are eternal. Since the craftsman can only imitate and not create, his work can only spoil the excellence of these eternal models. Thus the proper attitude of the craftsman toward the models is to "renounce his capacity for work" and do nothing. He can then behold the models and participate in their eternity. Arendt argues that this kind of contemplation "remains part and parcel of a fabrication process even though it divorced itself from all work."

The significant rupture in the hierarchy occurred when the traditional emphasis on both the product and the model was shifted entirely to the process of production, which was now regarded as the only source of reality. In other words, there was a shift from emphasis on ends to emphasis on means. Contemplation was no longer regarded as a source of truth, and it lost its position in the vita activa *itself. Arendt believes that this shift is the most significant aspect of the change to modern times.*

First among the activities within the *vita activa*[1] to rise to the position formerly occupied by contemplation were the activities of making and fabricating—the prerogatives of *homo faber*. This was natural enough, since it had been an instrument and therefore man in so far as he is a toolmaker that led to the modern revolution. From then on, all scientific progress has been most intimately tied up with the ever more refined development in the manufacture of new tools and instruments. While, for instance, Galileo's experiments with the fall of heavy bodies could have been made at any time in history if men had been inclined to seek truth through experiments, Michelson's experiment with the interferometer at the end of the nineteenth century relied not merely on his "experimental genius" but "required the general advance in technology," and therefore "could not have been made earlier than it was."[2]

□ From *The Human Condition* (Chicago: The University of Chicago Press, 1969), pp. 294-304.

It is not only the paraphernalia of instruments and hence the help man had to enlist from *homo faber* to acquire knowledge that caused these activities to rise from their former humble place in the hierarchy of human capacities. Even more decisive was the element of making and fabricating present in the experiment itself, which produces its own phenomena of observation and therefore depends from the very outset upon man's productive capacities. The use of the experiment for the purpose of knowledge was already the consequence of the conviction that one can know only what he has made himself, for this conviction meant that one might learn about those things man did not make by figuring out and imitating the processes through which they had come into being. The much discussed shift of emphasis in the history of science from the old questions of "what" or "why" something is to the new question of "how" it came into being is a direct consequence of this conviction, and its answer can only be found in the experiment. The experiment repeats the natural process as though man himself were about to make nature's objects, and although in the early stages of the modern age no responsible scientist would have dreamt of the extent to which man actually is capable of "making" nature, he nevertheless from the onset approached it from the standpoint of the One who made it, and this not for practical reasons of technical applicability but exclusively for the "theoretical" reason that certainty in knowledge could not be gained otherwise: "Give me matter and I will build a world from it, that is, give me matter and I will show you how a world developed from it."[3] These words of Kant show in a nutshell the modern blending of making and knowing, whereby it is as though a few centuries of knowing in the mode of making were needed as the apprenticeship to prepare modern man for making what he wanted to know.

Productivity and creativity, which were to become the highest ideals and even the idols of the modern age in its initial stages, are inherent standards of *homo faber*, of man as a builder and fabricator. However, there is another and perhaps even more significant element noticeable in the modern version of these faculties. The shift from the "why" and "what" to the "how" implies that the actual objects of knowledge can no longer be things or eternal motions but must be processes, and that the object of science therefore is no longer nature or the universe but the history, the story of the coming into being, of nature or life or the universe. Long before the modern age developed its unprecedented historical consciousness and the concept of history became dominant in modern philosophy, the natural sciences had developed into historical disciplines, until in the nineteenth century they added to the older disciplines of physics and chemistry, of zoology and botany, the new natural sciences of geology or history of the earth, biology or the history of life, anthropology or the history of human life, and, generally, natural history. In all these instances, development, the key concept of the historical sciences, became the central concept of the physical sciences as well. Nature, because it could be known only in processes which human ingenuity, the ingeniousness of *homo faber*, could repeat and remake in the experiment, became a process,[4] and all particular natural things derived their significance and meaning solely from their functions in the overall process. In the place of the concept of Being we now find the concept of Process. And whereas it is in the nature of Being to appear and thus disclose itself, it is in the nature of Process to remain invisible, to be something whose existence can only be inferred from the presence of certain phenomena. This process was originally the fabrication process which "disappears in the product," and it was based on the experience of *homo faber*, who knew that a production process necessarily precedes the actual existence of every object.

Yet while this insistence on the process of making or the insistence upon considering every thing as the result of a fabrication process is highly characteristic of *homo faber* and his sphere of experience, the exclusive emphasis the modern age placed on it at the expense of all interest in the things, the products themselves, is quite new. It actually transcends the mentality of man as a toolmaker and fabricator, for whom, on the contrary, the production process was a mere means to an end. Here, from the standpoint of *homo faber*, it was as though the means, the production process or development, was more important than the end, the finished product. The reason for this shift of emphasis is obvious: the scientist made only in order to know, not in order to produce things, and the product was a mere by-product, a side effect. Even today all true scientists will agree that the technical applicability of what they are doing is a mere by-product of their endeavor.

The full significance of this reversal of means and ends remained latent as long as the mechanistic world view, the world view of *homo faber* par excellence, was predominant. This view found its most plausible theory in the famous analogy of the relationship between nature and God with the relationship between the watch and the watchmaker. The point in our context is not so much that the eighteenth-century idea of God was obviously formed in the image of *homo faber* as that in this instance the process character of nature was still limited. Although all particular natural things had already been engulfed in the process from which they had come into being, nature as a whole was not yet a process but the more or less stable end product of a divine maker. The image of watch and watchmaker is so strikingly apposite precisely because it contains both the notion of a process character of nature in the image of the movements of the watch and the notion of its still intact object character in the image of the watch itself and its maker.

It is important at this point to remember that the specifically modern suspicion toward man's truth-receiving capacities, the mistrust of the given, and hence the new confidence in making and introspection which was inspired by the hope that in human consciousness there was a realm where knowing and producing would coincide, did not arise directly from the discovery of the Archimedean point outside the earth in the universe. They were, rather, the necessary consequences of this discovery for the discoverer himself, in so far as he was and remained an earth-bound creature. This close relationship of the modern mentality with philosophical reflection naturally implies that the victory of *homo faber* could not remain restricted to the employment of new methods in the natural sciences, the experiment and the mathematization of scientific inquiry. One of the most plausible consequences to be drawn from Cartesian doubt was to abandon the attempt to understand nature and generally to know about things not produced by man, and to turn instead exclusively to things that owed their existence to man. This kind of argument, in fact, made Vico turn his attention from natural science to history, which he thought to be the only sphere where man could obtain certain knowledge, precisely because he dealt here only with the products of human activity.[5] The modern discovery of history and historical consciousness owed one of its greatest impulses neither to a new enthusiasm for greatness of man, his doings and sufferings, nor to the belief that the meaning of human existence can be found in the story of mankind, but to the despair of human reason, which seemed adequate only when confronted with man-made objects.

Prior to the modern discovery of history but closely connected with it in its impulses are the seventeenth-century attempts to formulate new political philosophies or, rather, to invent the means and instruments with which to "make an artificial animal . . . called a Commonwealth, or State."[6] With Hobbes as with Descartes "the prime mover was doubt,"[7] and the chosen method to establish the "art of man," by which he would make and rule his own world as "God hath made and governs the world" by the art of nature, is also introspection, "to read in himself," since this reading will show him "the similitude of the thoughts and passions of one to the thoughts and passions of another." Here, too, the rules and standards by which to build and judge this most human of human "works of art"[8] do not lie outside of men, are not something men have in common in a worldly reality perceived by the senses or by the mind. They are, rather, inclosed in the inwardness of man, open only to introspection, so that their very validity rests on the assumption that "not . . . the objects of the passions" but the passions themselves are the same in every specimen of the species man-kind. Here again we find the image of the watch, this time applied to the human body and then used for the movements of the passions. The establishment of the Commonwealth, the human creation of "an artificial man," amounts to the building of an "automation [an engine] that moves [itself] by springs and wheels as doth a watch."

In other words, the process which, as we saw, invaded the natural sciences through the experiment, through the attempt to imitate under artificial conditions the process of "making" by which a natural thing came into existence, serves as well or even better as the principle for doing in the realm of human affairs. For here the processes of inner life, found in the passions through introspection, can become the standards and rules for the creation of the "automatic" life of that "artificial man" who is "the great Leviathan." The results yielded by introspection, the only method likely to deliver certain knowledge, are in the nature of movements: only the objects of the senses remain as they are and endure, precede and survive, the act of sensation; only the objects of the passions are permanent and fixed to the extent that they are not devoured by the attainment of some passionate desire; only the objects of thoughts, but never thinking itself, are beyond motion and perishability. Processes, therefore, and not ideas, the models and shapes of the things to be, become the guide for the making and fabricating activities of *homo faber* in the modern age.

NOTES

1. "*Vita activa*" means literally "the active life." With this term Arendt designates three human activities: labor, work, and action [ed. note].
2. Whitehead, *Science and the Modern World*, pp. 116-17.
3. "Gebet mir Materie, ich will eine Welt daraus bauen! das ist, gebet mir Materie, ich will euch zeigen, wie eine Welt daraus entstehen soll" (see Kant's Preface to his *Allgemeine Naturgeschichte und Theorie des Himmels*).
4. That "nature is a process," that therefore "the ultimate fact for sense-awareness is an event," that natural science deals only with occurrences, happenings, or events, but not with things and that "apart from happenings there is nothing" (see Whitehead, *The Concept of Nature*, pp. 53, 15, 66), belongs among the axioms of modern natural science in all its branches.

5. Vico [*De Nostri Temporis Studiorum Ratione*, ch 4] states explicity why he turned away from natural science. True knowledge of nature is impossible, because not man but God made it; God can know nature with the same certainty man knows geometry: *Geometrica demonstramus quia facimus; si physica demonstrare possemus, faceremus* ("We can prove geometry because we make it; to prove the physical we would have to make it"). This little treatise, written more than fifteen years before the first edition of the *Scienza Nuova* (1725), is interesting in more than one respect. Vico criticizes all existing sciences, but not yet for the sake of his new science of history: what he recommends is the study of moral and political science, which he finds unduly neglected. It must have been much later that the idea occurred to him that history is made by man as nature is made by God. This biographical development, though quite extraordinary in the early eighteenth century, became the rule approximately one hundred years later: each time the modern age had reason to hope for a new political philosophy, it received a philosophy of history instead.
6. Hobbes's Introduction to the *Leviathan*.
7. See Michael Oakeshott's excellent Introduction to the *Leviathan* (Blackwell's Political Texts), p. xiv.
8. *Ibid.*, p. lxiv.

PSYCHOLOGICAL

Where are we now and where are we headed?

ERICH FROMM

■ Erich Fromm *was born in 1900 in Frankfurt, and came to the United States in 1934. He is philosopher, a psychologist, and a writer. As a socialist humanist he concerns himself with the issue of man's isolation, loneliness, and alienation in an industrial society. His works provide a comprehensive attempt to uncover the objective roots of such feelings, and to expound socialist humanist solutions to this general social malaise.*

In this selection Fromm discusses the future technetronic society. It is programmed by two principles. The first is "the maxim that something ought *to be done because it is technically* possible *to do it." The second is "that of maximal efficiency and output." The social consequences of these principles are shown to be varied and to include such significant effects as dehumanization of the individual, increased passivity and conformity, and decreased creativity. This state of affairs leads to a "syndrome of alienation," and to a split between thought and feeling in the individual, causing him to behave like a robot. Fromm concludes that "when the majority of men are like robots, then indeed there will be no problem in building robots who are like men."*

THE PRESENT TECHNOLOGICAL SOCIETY

a. Its principles

The technetronic society may be the system of the future, but it is not yet here; it can develop from what is already here, and it probably will, unless a sufficient number of people see the danger and redirect our course. In order to do so, it is necessary to understand in greater detail the operation of the present technological system and the effect it has on man.

What are the guiding principles of this system as it is today?

It is programed by two principles that direct the efforts and thoughts of everyone working in it: The first principle is the maxim that something *ought* to be done because it is technically *possible* to do it. If it is possible to build nuclear weapons, they must be built even if they might destroy us all. If it is possible to travel to the moon or to the planets, it must be done, even if at the expense of many unfulfilled needs here on earth. This principle means the negation of all values which the humanist tradition has developed. This tradition said that something should be done because it is needed for man, for his growth, joy, and reason, because it is beautiful, good, or true. Once the principle is accepted that something ought to be done because it is technically possible to do it, all other values are dethroned, and technological development becomes the foundation of ethics.[1]

The second principle is that of *maximal efficiency and output*. The requirement of maximal efficiency leads as a consequence to the requirement of minimal individuality. The social machine works more efficiently, so it is believed, if individuals are cut down to purely quantifiable units whose personalities can be expressed on punched cards. These units can be administered more easily by bureaucratic rules because

☐ From pp. 32-46 in *The Revolution of Hope* by Erich Fromm, volume thirty-eight of World Perspective Series, planned and edited by Ruth Nanda Anshen.

they do not make trouble or create friction. In order to reach this result, men must be de-individualized and taught to find their identity in the corporation rather than in themselves.

The question of economic efficiency requires careful thought. The issue of being economically efficient, that is to say, using the smallest possible amount of resources to obtain maximal effect, should be placed in a historical and evolutionary context. The question is obviously more important in a society where real material scarcity is the prime fact of life, and its importance diminishes as the productive powers of a society advance.

A second line of investigation should be a full consideration of the fact that efficiency is only a known element in already existing activities. Since we do not know much about the efficiency or inefficiency of untried approaches, one must be careful in pleading for things as they are on the grounds of efficiency. Furthermore, one must be very careful to think through and specify the area and time period being examined. What may appear efficient by a narrow definition can be highly inefficient if the time and scope of the discussion are broadened. In economics there is increasing awareness of what are called "neighborhood effects"; that is, effects that go beyond the immediate activity and are often neglected in considering benefits and costs. One example would be evaluating the efficiency of a particular industrial project only in terms of the immediate effects on this enterprise—forgetting, for instance, that waste materials deposited in nearby streams and the air represent a costly and a serious inefficiency with regard to the community. We need to clearly develop standards of efficiency that take account of time and society's interest as a whole. Eventually, the human element needs to be taken into account as a basic factor in the system whose efficiency we try to examine.

Dehumanization in the name of efficiency is an all-too-common occurrence; e.g., giant telephone systems employing Brave New World techniques of recording operators' contacts with customers and asking customers to evaluate workers' performance and attitudes, etc.—all aimed at instilling "proper" employee attitude, standardizing service, and increasing efficiency. From the narrow perspective of immediate company purposes, this may yield docile, manageable workers, and thus enhance company efficiency. In terms of the employees, as human beings, the effect is to engender feelings of inadequacy, anxiety, and frustration, which may lead to either indifference or hostility. In broader terms, even efficiency may not be served, since the company and society at large doubtless pay a heavy price for these practices.

Another general practice in organizing work is to constantly remove elements of creativity (involving an element of risk or uncertainty) and group work by dividing and subdividing tasks to the point where no judgment or interpersonal contact remains or is required. Workers and technicians are by no means insensitive to this process. Their frustration is often perceptive and articulate, and comments such as "We are human" and "The work is not fit for human beings" are not uncommon. Again, efficiency in a narrow sense can be demoralizing and costly in individual and social terms.

If we are only concerned with input-output figures, a system may give the impression of efficiency. If we take into account what the given methods do to the human beings in the system, we may discover that they are bored, anxious, depressed, tense, etc. The result would be a twofold one: (1) Their imagination would be hobbled by their psychic pathology, they would be uncreative, their thinking would be routinized and bureaucratic, and hence they would not come up with new ideas and solutions which would contribute to a more productive development of the system; altogether, their energy would be considerably lowered. (2) They would suffer from many physical ills, which are the result of stress and tension; this loss in health is also a loss for the system. Furthermore, if one examines what this tension and anxiety do to them in their relationship to their wives and children, and in their functioning as responsible citizens, it may turn out that for the system as a whole the seemingly efficient method is most inefficient, not only in human terms but also as measured by merely economic criteria.

To sum up: efficiency is desirable in any kind of purposeful activity. But it should be examined in terms of the larger systems, of which the system under study is only a part; it should take account of the human factor within the system. Eventually efficiency as such should not be a *dominant* norm in any kind of enterprise.

The other aspect of the same principle, that of *maximum output,* formulated very simply, maintains that the more we produce of whatever we produce, the better. The success of the economy of the country is measured by its rise of total production. So is the success of a company. Ford may lose several hundred million dollars by the failure of a costly new model, like the Edsel, but this is only a minor mishap as long as the production curve rises. The growth of the economy is visualized in terms of ever-increasing production, and there is no vision of a limit yet where production may be stabilized. The comparison between countries rests upon the same principle. The Soviet Union hopes to surpass the United States by accomplishing a more rapid rise in economic growth.

Not only industrial production is ruled by the principle of continuous and limitless acceleration. The educational system has the same criterion: the more college graduates, the better. The same in sports: every new record is looked upon as progress. Even the attitude toward the weather seems to be determined by the same principle. It is emphasized that this is "the hottest day in the decade," or the coldest, as the case may be, and I suppose some people are comforted for the inconvenience by the proud feeling that they are witnesses to the record temperature. One could go on endlessly giving examples of the concept that constant increase of quantity constitutes the goal of our life; in fact, that it is what is meant by "progress."

Few people raise the question of *quality*, or what all this increase in quantity is good for. This omission is evident in a society which is not centered around man any more, in which one aspect, that of quantity, has choked all others. It is easy to see that the predominance of this principle of "the more the better" leads to an imbalance in the whole system. If all efforts are bent on doing *more*, the quality of living loses all importance, and activities that once were means become ends.[2]

If the overriding economic principle is that we produce more and more, the consumer must be prepared to want—that is, to consume—more and more. Industry does not rely on the consumer's spontaneous desires for more and more commodities. By building in obsolescence it often forces him to buy new things when the old ones could last much longer. By changes in styling of products, dresses, durable goods, and even food, it forces him psychologically to buy more than he might need or want. But industry, in its need for increased production, does not rely on the consumer's needs and wants but to a considerable extent on advertising, which is the most important offensive against the consumer's right to know what he wants. The spending of 16.5 billion dollars on direct advertising in 1966 (in newspapers, magazines, radio, TV) may sound like an irrational and wasteful use of human talents, of paper and print. But it is not irrational in a sys- that believes that increasing production and hence consumption is a vital feature of our economic system, without which it would collapse. If we add to the cost of advertising the considerable cost for restyling of durable goods, especially cars, and of packaging, which partly is another form of whetting the consumer's appetite, it is clear that industry is willing to pay a high price for the guarantee of the upward production and sales curve.

The anxiety of industry about what might happen to our economy if our style of life changed is expressed in this brief quote by a leading investment banker:

> Clothing would be purchased for its utility; food would be bought on the basis of economy and nutritional value; automobiles would be stripped to essentials and held by the same owners for the full 10 or 15 years of their useful lives; homes would be built and maintained for their characteristics of shelter, without regard to style or neighborhood. And what would happen to a market dependent upon new models, new styles, new ideas?[3]

b. Its effect on man

What is the effect of this type of organization on man? It reduces man to an appendage of the machine, ruled by its very rhythm and demands. It transforms him into *Homo consumens*, the total consumer, whose only aim is to *have* more and to *use* more. This society produces many useless things, and to the same degree many useless people. Man, as a cog in the production machine, becomes a thing, and ceases to be human. He spends his time doing things in which he is not interested, with people in whom he is not interested, producing things in which he is not interested; and when he is not producing, he is consuming. He is the eternal suckling with the open mouth, "taking in," without effort and without inner activeness, whatever the boredom-preventing (and boredom-producing) industry forces on him—cigarettes, liquor, movies, television, sports, lectures—limited only by what he can afford. But the boredom-preventing industry, that is to say, the gadget-selling industry, the automobile industry, the movie industry, the television industry, and so on, can only succeed in preventing the boredom from being conscious. In fact, they increase the boredom, as a salty drink taken to quench the thirst increases it. However unconscious, boredom remains boredom nevertheless.

The passiveness of man in industrial society today is one of his most characteristic and pathological features. He takes in, he wants to be fed, but he does not move, initiate, he does not digest his food, as it were. He does not reacquire in a productive fashion what he inherited, but he amasses it or consumes it. He suffers from a severe systemic deficiency, not too dissimilar to that which one finds in more extreme forms in depressed people.

Man's passiveness is only one symptom among a total syndrome, which one may call the "syndrome of alienation." Being passive, he does not relate himself to the world actively and is forced to submit to his idols and their demands. Hence, he feels powerless, lonely, and anxious. He has little sense of integrity or self-identity. Conformity seems to be the only way to avoid intolerable anxiety—and even conformity does not always alleviate his anxiety.

No American writer has perceived this dynamism more clearly than Thorstein Veblen. He wrote:

> In all the received formulations of economic theory, whether at the hands of the English economists or those of the continent, the human material with which the inquiry is concerned is conceived in hedonistic terms; that is to say, in terms of a passive and substantially inert and immutably given human nature. . . . The hedonistic conception of man is that of a lightning calculator of pleasures and pains, who oscillates like a homogeneous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact. He has neither antecedent nor consequent. He is an isolated, definitive human datum, in stable equilibrium except for the buffets of the impinging forces that displace him in one direction or another. Self-imposed in elemental space, he spins symmetrically about his own spiritual axis until the parallelogram of forces bears down upon him, whereupon he follows the line of the resultant. When the force of the impact is spent, he comes to rest, a self contained globule of desire as before. Spiritually, the hedonistic man is not a prime mover. *He is not the seat of a process of living, except in the sense that he is subject to a series of permutations enforced upon him by circumstances external and alien to him.*[4]

Aside from the pathological traits that are rooted in passiveness, there are others which are important for the understanding of today's pathology of normalcy. I am referring to the growing split of cerebral-intellectual function from affective-emotional experience; the split between thought from feeling, mind from the heart, truth from passion.

Logical thought is not rational if it is merely logical[5] and not guided by the concern for life, and by the inquiry into the total process of living in all its concreteness and with all its contradictions. On the other hand, not only thinking but also emotions can be rational. "*Le coeur a ses raisons que la raison ne connaît point,*" as Pascal put it. (The heart has its reasons which reason knows nothing of.) Rationality in emotional life means that the emotions affirm and help the person's psychic structure to maintain a harmonious balance and at the same time to assist its growth. Thus, for instance, irrational love is love which enhances the person's dependency, hence anxiety and hostility. Rational love is a love which relates a person intimately to another, at the same time preserving his independence and integrity.

Reason flows from the blending of rational thought and feeling. If the two functions are torn apart, thinking deteriorates into schizoid intellectual activity, and feeling deteriorates into neurotic life-damaging passions.

The split between thought and affect leads to a sickness, to a low-grade chronic schizophrenia, from which the new man of the technetronic age begins to suffer. In the social sciences it has become fashionable to think about human problems with no reference to the feelings related to these problems. It is assumed that scientific objectivity demands that thoughts and theories concerning man be emptied of all emotional concern with man.

An example of this emotion-free thinking is Herman Kahn's book on thermonuclear warfare. The question is discussed: how many millions of dead Americans are "acceptable" if we use as a criterion the ability to rebuild the economic machine after nuclear war in a reasonably short time so that it is as good as or better than before. Figures for GNP and population increase or decrease are the basic categories in this kind of thinking, while the question of the human results of nuclear war in terms of suffering, pain, brutalization, etc., is left aside.

Kahn's *The Year 2000* is another example of the writing which we may expect in the completely alienated megamachine society. Kahn's concern is that of the figures for production, population increase, and various scenarios for war or peace, as the case may be. He impresses many readers because they mistake the thousands of little data which he combines in ever-changing kaleidoscopic pictures for erudition or profundity. They do not notice the basic superficiality in his reasoning and the lack of the human dimension in his description of the future.

When I speak here of low-grade chronic schizophrenia, a brief explanation seems to be needed. Schizophrenia, like any other psychotic state, must be defined not only in psychiatric terms but also in social terms. Schizophrenic experience *beyond* a certain threshold would be considered a sickness in any society, since those suffering from it would be unable to function under any social circumstances (unless the schizophrenic is elevated into the status of a god, shaman, saint, priest, etc.). But there are low-grade chronic forms of psychoses which can be shared by millions of people and which—precisely because they do not go beyond a certain threshold—do not prevent these people from functioning socially. As long as they share their sickness with millions of others, they have the satisfactory feeling of not being alone; in other words, they avoid that sense of complete isolation which is so characteristic of full-fledged psychosis. On the contrary, they look at themselves as normal and at those who have not lost the link between heart and mind as being "crazy." In all low-grade forms of psychoses, the definition of sickness depends on the question as to whether the pathology is shared or not. Just as there is low-grade chronic schizophrenia, so there exist also low-grade chronic paranoia and depression. And there is plenty of evidence that among certain strata of the population, particularly on occasions where a war threatens, the paranoid elements increase but are not felt as pathological as long as they are common.[6]

The tendency to install technical progress as the highest value is linked up not only with our overemphasis on intellect but, most importantly, with a deep emotional attraction to the mechanical, to all that is not alive, to all that is man-made. This attraction to the non-alive, which is in its more extreme form an attraction to death and decay (necrophilia), leads even in its less drastic form to indifference toward life instead of "reverence for life." Those who are attracted to the non-alive are the people who prefer "law and order" to living structure, bureaucratic to spontaneous methods, gadgets to living beings, repetition to originality, neatness to exuberance, hoarding to spending. They want to control life because they are afraid of its uncontrollable spontaneity; they would rather kill it than to expose themselves to it and merge with the world around them. They often gamble with death because they are not rooted in life; their courage is the courage to die and the symbol of their ultimate courage is the Russian roulette.[7] The rate of our automobile accidents and the preparation for thermonuclear war are a testimony to this readiness to gamble with death. And who would not eventually prefer this exciting gamble to the boring unaliveness of the organization man?

One symptom of the attraction of the merely mechanical is the growing popularity, among some scientists and the public, of the idea that it will be possible to construct computers which are no different from man in thinking, feeling, or any other aspect of functioning.[8] The main problem, it seems to me, is not whether such a computer-man can be constructed; it is rather why the idea is becoming so popular in a historical period when nothing seems to be more important than to transform the existing man into a more rational, harmonious, and peace-loving being. One cannot help being suspicious that often the attraction of the computer-man idea is the expression of a flight from life and from humane experience into the mechanical and purely cerebral.

The possibility that we can build robots who are like men belongs, if anywhere, to the future. But the present already shows us men who act like robots. When the majority of men are like robots, then indeed there will be no problem in building robots who are like men. The idea of the manlike computer is a good example of the alternative between the human and the inhuman use of machines. The computer can serve the enhancement of life in many respects. But the idea that it replaces man and life is the manifestation of the pathology of today.

The fascination with the merely mechanical is supplemented by an increasing popularity of conceptions that stress the animal nature of man and the instinctive roots of his emotions or actions. Freud's was such an instinctive psychology; but the importance of his concept of libido is secondary in comparison with his fundamental discovery of the unconscious process in waking life or in sleep. The most popular recent authors who stress instinctual animal heredity, like Konrad Lorenz *(On Aggression)* or Desmond Morris *(The Naked Ape)*, have not offered any new or valuable insights into the specific human problem as Freud has done; they satisfy the wish of many to look at themselves as determined by instincts and thus to camouflage their true and bothersome human problems.[9] The dream of many people seems to be to combine the emotions of a primate with a computerlike brain. If this dream could be fulfilled, the problem of human freedom and of responsibility would seem to disappear. Man's feelings would be determined by his instincts, his reason by the computer; man would not have to give an answer to the questions his existence asks him. Whether one likes the dream or not, its realization is impossible; the naked ape with the computer brain would cease to be human, or rather "he" would not *be*.[10]

Among the technological society's pathogenic effects upon man, two more must be mentioned: the disappearance of *privacy* and of *personal human contact*.

"Privacy" is a complex concept. It was and is a privilege of the middle and upper classes, since its very basis, private space, is costly. This privilege, however, can become a common good with other economic privileges. Aside from this economic factor, it was also based on a hoarding tendency in which *my* private life was *mine* and nobody else's, as was *my* house and any other property. It was also a concomitant of *cant,* of the discrepancy between moral appearances and reality. Yet when all these qualifications are made, privacy still seems to be an important condition for a person's productive development. First of all, because privacy is necessary to collect oneself and to free oneself from the constant "noise" of people's chatter and intrusion, which interferes with one's own mental processes. If all private data are transformed into public data, experiences will tend to become more shallow and more alike. People will be afraid to feel the "wrong thing"; they will become more accessible to psychological manipulation which, through psychological testing, tries to establish norms for "desirable," "normal," "healthy" attitudes. Considering that these tests are applied in order to help the companies and government agencies to find the people with the "best" attitudes, the use of psychological tests, which is by now an almost general condition for getting a good job, constitutes a severe infringement on the citizen's freedom. Unfortunately, a large number of psychologists devote whatever knowledge of man they have to his manipulation in the interests of what the big organization considers efficiency. Thus, psychologists become an important part of the industrial and governmental system while claiming that their activities serve the optimal development of man. This claim is based on the rationalization that what is best for the corporation is best for man. It is important that the managers understand that much of what they get from psychological testing is based on the very limited picture of man which, in fact, management requirements have transmitted to the psychologists, who in turn give it back to management, allegedly as a result of an independent study of man. It hardly needs to be said that the intrusion of privacy may lead to a control of the individual which is more total and could be more devastating than what totalitarian states have demonstrated thus far. Orwell's 1984 will need much assistance from testing, conditioning, and smoothing-out psychologists in order to come true. It is of vital importance to distinguish between a psychology that understands and aims at the well-being of man and a psychology that studies man as an object, with the aim of making him more useful for the technological society.

NOTES

[1]While revising this manuscript I read a paper by Hasan Ozbekhan, "The Triumph of Technology: 'Can' Implies 'Ought.'" This paper, adapted from an invited presentation at MIT and published in mimeographed form by System Development Corporation, Santa Monica, California, was sent to me by the courtesy of Mr. George Weinwurm. As the title indicates, Ozbekhan expresses the same concept as the one I present in the text. His is a brilliant presentation of the problem from the standpoint of an outstanding specialist in the field of management science, and I find it a very encouraging fact that the same idea appears in the work of authors in fields as different as his and mine. I quote a sentence that shows the identity of his concept and the one presented in the text: "Thus, feasibility, which is a strategic concept, becomes elevated into a normative concept, with the result that whatever technological reality indicates we *can* do is taken as implying that we *must* do it" (p. 7).

[2]I find in C. West Churchman's *Challenge to Reason* (New York: McGraw-Hill, 1968) an excellent formulation of the problem:

"If we explore this idea of a larger and larger model of systems, we may be able to see in what sense completeness represents a challenge to reason. One model that seems to be a good candidate for completeness is called an *allocation* model; it views the world as a system of activities that use resources to "output" usable products.

"The process of reasoning in this model is very simple. One searches for a central quantitative measure of system performance, which has the characteristic: the more of this quantity the better. For example, the more profit a firm makes, the better. The more qualified students a university graduates, the better. The more food we produce, the better. It will turn out that the particular choice of the measure of system performance is not critical, so long as it is a measure of general concern.

"We take this desirable measure of performance and relate it to the feasible activities of the system. The activities may be the operations of various manufacturing plants, of schools and universities, of farms, and so on. Each significant activity contributes to the desirable quantity in some recognizable way. The contribution, in fact, can often be expressed in a mathematical function that maps the amount of activity onto the amount of the desirable quantity. The more sales of a certain product, the higher the profit of a firm. The more courses we teach, the more graduates we have. The more fertilizer we use, the more food [pp. 156-57]."

[3]Paul Mazur, *The Standards We Raise*, New York, 1953, p. 32.

[4]"Why Is Economics Not an Evolutionary Science?," in *The Place of Science in Modern Civilization and Other Essays* (New York: B. W. Huebsch, 1919), p. 73. (Emphasis added.)

[5]Paranoid thinking is characterized by the fact that it can be completely logical, yet lack any guidance by concern or concrete inquiry into reality; in other words, logic does not exclude madness.

[6]The difference between that which is considered to be sickness and that which is considered to be normal becomes apparent in the following example. If a man declared that in order to free our cities from air pollution, factories, automobiles, airplanes, etc., would have to be destroyed, nobody would doubt that he was insane. But if there is a consensus that in order to protect our life, our freedom, our culture, or that of other nations which we feel obliged to protect, thermonuclear war might be required as a last resort, such opinion appears to be perfectly sane. The difference is not at all in the kind of thinking employed but merely in that the first idea is not shared and hence appears abnormal while the second is shared by millions of people and by powerful governments and hence appears to be normal.

[7]Michael Maccoby has demonstrated the incidence of the life-loving versus the death-loving syndrome in various populations by the application of an "interpretative" questionnaire. Cf. his "Polling Emotional Attitudes in Relation to Political Choices" (to be published).

[8]Dean E. Wooldridge, for instance, in *Mechanical Man* (New York: McGraw-Hill, 1968), writes that it will be possible to manufacture computers synthetically which are "completely undistinguishable from human beings produced in the usual manner" [!] (p. 172). Marvin L. Minsky, a great authority on computers, writes in his book *Computation* (Englewood Cliffs, N.J.: Prentice-Hall, 1967): "There is no reason to suppose machines have any limitations not shared by man" (p. vii).

[9]This criticism of Lorenz refers only to that part of his work in which he deals by analogy with the psychological problems of man, not with his work in the field of animal behavior and instinct theory.

[10]In revising this manuscript I became aware that Lewis Mumford had expressed the same idea in 1954 in *In the Name of Sanity* (New York: Harcourt, Brace & Co.):

"Modern man, therefore, now approaches the last act of his tragedy, and I could not, even if I would, conceal its finality or its horror. We have lived to witness the joining, in intimate partnership, of the automaton and the id, the id rising from the lower depths of the unconscious, and the automaton, the machine-like thinker and the man-like machine, wholly detached from other life-maintaining functions and human reactions, descending from the heights of conscious thought. The first force has proved more brutal, when released from the whole personality, than the most savage of beasts; the other force, so impervious to human emotions, human anxieties, human purposes, so committed to answering only the limited range of questions for which its apparatus was originally loaded, that it lacks the saving intelligence to turn off its own compulsive mechanism, even though it is pushing science as well as civilization to its own doom [p. 198]."

PSYCHOLOGICAL

The dialectic of civilization

HERBERT MARCUSE

■ Herbert Marcuse *(1898-1979) was born in Berlin, Germany, and immigrated to the United States in 1934. He was a philosopher, psychologist, and social critic who devoted most of his life to the fight against fascism. He took a stand against it in Europe, and later wrote a scathing critique on repressive elements in the American industrial society and the Soviet bureaucratic state. In* One Dimensional Man *(1964) he argued that, in the American industrial society, man's nature has been distorted, releasing as a consequence an unusual amount of aggression. He warned against the destruction that can result from such a state of affairs. Among his works are* Reason and Revolution *(1941) and* Eros and Civilization *(1955), from which the following selection is taken.*

In this selection Marcuse creatively expounds the views of Freud. As we already know, Freud viewed civilization as being based primarily on the suppression of sexual instincts. Marcuse observes that for Freud there is no "instinct of workmanship." Work is unpleasant. But "civilization is first of all progress in work." Thus the energy for work must be borrowed from the primary instincts (sexual instincts and destructive instincts). Since civilization is mainly the work of Eros (the life instincts), which derives its strength from the sexual instincts, it follows that the energy used for work is borrowed chiefly from the libido, the reservoir of sexual energy. But by borrowing from the libido, Eros is in turn weakened. This impairs the ability of Eros to effectively "bind" the destructive instincts. As a result "civilization tends towards self-destruction." Marcuse evaluates this Freudian argument, introducing in the process the distinction between "work" and "alienated labor," and his famous concept of "surplus repression."

Civilization is first of all progress in *work*—that is, work for the procurement and augmentation of the necessities of life. This work is normally without satisfaction in itself; to Freud it is unpleasurable, painful. In Freud's metapsychology there is no room for an original "instinct of workmanship," "mastery instinct," etc.[1] The notion of the conservative nature of the instincts under the rule of the pleasure and Nirvana principles strictly precludes such assumptions. When Freud incidentally mentions the "natural human aversion to work,"[2] he only draws the inference from his basic theoretical conception. The instinctual syndrome "unhappiness and work" recurs throughout Freud's writings,[3] and his interpretation of the Prometheus myth is centered on the connection between curbing of sexual passion and civilized work.[4] The basic work in civilization is non-libidinal, is labor; labor is "unpleasantness," and such unpleasantness has to be enforced. "For what motive would induce man to put his sexual energy to other uses if by any disposal of it he could obtain fully satisfying pleasure? He would never let go of this pleasure and would make no further progress."[5] If there is no original "work instinct," then the energy required for (unpleasurable) work must be "withdrawn" from the primary instincts—from the sexual and from the destructive instincts. Since civilization is mainly the work of Eros, it is first of all withdrawal of libido: culture "obtains a great part of the mental energy it needs by subtracting it from sexuality."[6]

But not only the work impulses are thus fed by aim-inhibited sexuality. The specifically "social instincts" (such as the "affectionate relations between parents and children, . . . feelings of friendship, and the emotional ties in marriage") contain impulses which are "held back by internal resistance" from attaining their aims;[7] only by virtue of such renunciation do they become sociable. Each individual contributes his renunciations (first under the impact of external compulsion, then internally), and from "these sources the common stock of the material and ideal wealth of civilization has been accumulated."[8] Although Freud remarks that these social instincts "need not be described as sublimated" (because they have not abandoned their sexual aims but rest content with "certain approximations to satisfaction"), he calls them "closely related" to sublimation.[9] Thus the main sphere of civilization appears as a sphere of *sublimation*. But sublimation involves *desexualization*. Even if and where it draws on a reservoir of "neutral displaceable energy" in the ego and in the id, this neutral energy "proceeds from the narcissistic reservoir

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☐ From *Eros and Civilization: A Philosophical Inquiry Into Freud* (Boston: The Beacon Press, 1960), pp. 81-88. Reprinted by permission of Penguin Books Ltd, The Beacon Press, and the author.

of libido," i.e., it is desexualized Eros.[10] The process of sublimation alters the balance in the instinctual structure. Life is the fusion of Eros and death instinct; in this fusion, Eros has subdued its hostile partner. However:

> After sublimation the erotic component no longer has the power to bind the whole of the destructive elements that were previously combined with it, and these are released in the form of inclinations to aggression and destruction.[11]

Culture demands continuous sublimation; it thereby weakens Eros, the builder of culture. And desexualization, by weakening Eros, unbinds the destructive impulses. Civilization is thus threatened by an instinctual de-fusion, in which the death instinct strives to gain ascendancy over the life instincts. Originating in renunciation and developing under progressive renunciation, civilization tends toward self-destruction.

This argument runs too smooth to be true. A number of objections arise. In the first place, not all work involves desexualization, and not all work is unpleasurable, is renunciation. Secondly, the inhibitions enforced by culture also affect—and perhaps even chiefly affect—the derivatives of the death instinct, aggressiveness and the destruction impulses. In this respect at least, cultural inhibition would accrue to the strength of Eros. Moreover, work in civilization is itself to a great extent *social utilization* of aggressive impulses and is thus work in the service of Eros. An adequate discussion of these problems presupposes that the theory of the instincts is freed from its exclusive orientation on the performance principle, that the image of a non-repressive civilization (which the very achievements of the performance principle suggest) is examined as to its substance. Such an attempt will be made in the last part of this study; here, some tentative clarifications must suffice.

The psychical sources and resources of work, and its relation to sublimation, constitute one of the most neglected areas of psychoanalytic theory. Perhaps nowhere else has psychoanalysis so consistently succumbed to the official ideology of the blessings of "productivity."[12] Small wonder then, that in the Neo-Freudian schools, where (as we shall see in the Epilogue) the ideological trends in psychoanalysis triumph over its theory, the tenor of work morality is all-pervasive. The "orthodox" discussion is almost in its entirety focused on "creative" work, especially art, while work in the realm of necessity—labor—is relegated to the background.

To be sure, there is a mode of work which offers a high degree of libidinal satisfaction, which is pleasurable in its execution. And artistic work, where it is genuine, seems to grow out of a non-repressive instinctual constellation and to envisage non-repressive aims—so much so that the term *sublimation* seems to require considerable modification if applied to this kind of work. But the bulk of the work relations on which civilization rests is of a very different kind. Freud notes that the "daily work of earning a livelihood affords particular satisfaction when it has been selected by free choice."[13] However, if "free choice" means more than a small selection between pre-established necessities, and if the inclinations and impulses used in work are other than those preshaped by a repressive reality principle, then satisfaction in daily work is only a rare privilege. The work that created and enlarged the material basis of civilization was chiefly labor, alienated labor, painful and miserable—and still is. The performance of such work hardly gratifies *individual* needs and inclinations. It was imposed upon man by brute necessity and brute force; if alienated labor has anything to do with Eros, it must be very indirectly, and with a considerably sublimated and weakened Eros.

But does not the civilized inhibition of *aggressive* impulses in work offset the weakening of Eros? Aggressive as well as libidinal impulses are supposed to be satisfied in work "by way of sublimation," and the culturally beneficial "sadistic character" of work has often been emphasized.[14] The development of technics and technological rationality absorbs to a great extent the "modified" destructive instincts:

> The instinct of destruction, when tempered and harnessed (as it were, inhibited in its aim) and directed towards objects, is compelled to provide the ego with satisfaction of its needs and with power over nature.[15]

Technics provide the very basis for progress; technological rationality sets the mental and behaviorist pattern for productive performance, and "power over nature" has become practically identical with civilization. Is the destructiveness sublimated in these activities sufficiently subdued and diverted to assure the work of Eros? It seems that socially useful destructiveness is less sublimated than socially useful libido. To be sure, the diversion of destructiveness from the ego to the external world secured the growth of civilization. However, extroverted destruction remains destruction: its objects are in most cases actually and violently assailed, deprived of their form, and reconstructed only after partial destruction; units are forcibly divided, and the component parts forcibly rearranged. Nature is literally "violated." Only in certain categories of sublimated aggressiveness (as in surgical practice) does such violation directly strengthen the life of its object. Destructiveness, in extent and intent, seems to be more directly satisfied in civilization than the libido.

However, while the destructive impulses are thus being satisfied, such satisfaction cannot stabilize their energy in the service of Eros. Their destructive force must drive them beyond this servitude and sublimation, for their aim is, not matter, not nature, not any object, but life itself. If they are the derivatives of the death instinct, then they cannot accept as final any "substitutes." Then, through constructive technological destruction, through the constructive violation of nature, the instincts would still operate toward the annihilation of life. The radical hypothesis of *Beyond the Pleasure Principle* would stand: the instincts of self-preservation, self-assertion, and mastery, in so far as they have absorbed this destructiveness, would have the function of assuring the organism's "own path to death." Freud retracted this hypothesis as soon as he had advanced it, but his formulations in *Civilization and Its Discontents* seem to restore its essential content. And the fact that the destruction of life (human and animal) has progressed with the progress of civilization, that cruelty and hatred and the scientific extermination of men have increased in relation to the real possibility of the elimination of oppression—this feature of late industrial civilization would have instinctual roots which perpetuate destructiveness beyond all rationality. The growing mastery of nature then would, with the growing productivity of labor, develop and fulfill the human needs *only as a by-product:* increasing cultural wealth and knowledge would provide the material for progressive destruction and the need for increasing instinctual repression.

This thesis implies the existence of objective criteria for gauging the degree of instinctual repression at a given stage of civilization. However, repression is largely unconscious and automatic, while its degree is measureable only in the light of consciousness. The differential between (phylogenetically necessary) repression and surplus-repression may provide the criteria. Within the total structure of the repressed personality, surplus-repression is that portion which is the result of specific societal conditions sustained in the specific interest of domination. The extent of this surplus-repression provides the standard of measurement: the smaller it is, the less repressive is the stage of civilization. The distinction is equivalent to that between the biological and the historical sources of human suffering. Of the three "sources of human suffering" which Freud enumerates—namely, "the superior force of nature, the disposition to decay of our bodies, and the inadequacy of our methods of regulating human relations in the family, the community and the state"[16]—at least the first and the last are in a strict sense *historical* sources; the superiority of nature and the organization of societal relations have essentially changed in the development of civilization. Consequently, the necessity of repression, and of the suffering derived from it, varies with the maturity of civilization, with the extent of the achieved rational mastery of nature and of society. Objectively, the need for instinctual inhibition and restraint depends on the need for toil and delayed satisfaction. The same and even a reduced scope of instinctual regimentation would constitute a higher degree of repression at a mature stage of civilization, when the need for renunciation and toil is greatly reduced by material and intellectual progress—when civilization could actually afford a considerable release of instinctual energy expended for domination and toil. Scope and intensity of instinctual repression obtain their full significance only in relation to the historically possible extent of freedom.

NOTES

1. Ives Hendrick, "Work and the Pleasure Principle," in *Psychoanalytic Quarterly*, XII (1943), 314.
2. *Civilization and Its Discontents*, p. 34 note.
3. In a letter of April 16, 1896, he speaks of the "moderate misery necessary for intensive work." Ernest Jones, *The Life and Work of Sigmund Freud*, Vol. I (New York: Basic Books, 1953), p. 305.
4. *Civilization and Its Discontents*, pp. 50-51 note; *Collected Papers*, V, 288ff.
5. "The Most Prevalent Form of Degradation in Erotic Life," in *Collected Papers*, IV, 216.
6. *Civilization and Its Discontents*, p. 74.
7. "The Libido Theory," in *Collected Papers*, V, 134.
8. "'Civilized' Sexual Morality . . . ," p. 82.

9. "The Libido Theory," p. 134.
10. *The Ego and the Id* (London: Hogarth Press, 1950), pp. 38, 61-63. See Edward Glover, "Sublimation, Substitution, and Social Anxiety," in *International Journal of Psychoanalysis*, Vol. XII, No. 3 (1931), p. 264.
11. *The Ego and the Id*, p. 80.
12. Ives Hendrick's article cited above is a striking example.
13. *Civilization and Its Discontents*, p. 34 note.
14. See Alfred Winterstein, "Zur Psychologie der Arbeit," in *Imago*, XVIII (1932), 142.
15. *Civilization and Its Discontents*, p. 101.
16. *Civilization and Its Discontents*, p. 43.

SOCIOLOGICAL

The three phases of the machine civilization

LEWIS MUMFORD

▪ Lewis Mumford, *born in 1895 in Flushing, New York, is a noted author and social critic whose areas of interest include such topics as cities, technics, and the development of human culture. He has served as an acting editor of* The Sociological Review *(London) and as a co-editor of* The American Caravan. *He has also held teaching posts at various American Universities, and has received numerous honors from prestigious societies in his field. Among his books are* The Myth of the Machine *(vol. I, 1967; vol. II, 1970) and* Technics and Civilization *(1934), from which the following passages are excerpted.*

The author presents here a three-stage theory of the history of modern technology. According to Mumford, the dawn of modern technology "stretches roughly from the year 1000 to 1750," a period that he calls the eotechnic phase. During this early phase, technology was mainly based on two sources of power: wood and water. By the middle of the eighteenth century, the eotechnic phase had faded into the paleotechnic phase, in which the sources of power were mainly coal and iron. While, during the eotechnic phase, technology was evenly distributed over a territory, the new phase ushered in the clustering of industries. Crowded industrial centers appeared, and with them disease, poverty, and other ills.

By the middle of the nineteenth century, many of the major discoveries that ushered in the third phase had already been made. Thus the neotechnic phase, based on electricity and alloys, began to slowly replace the paleotechnic phase. Like the eotechnic phase, this phase did not require the clustering of industries; it promised to restore healthier and happier surroundings to the worker.

1. THE EOTECHNIC PHASE

Technical syncretism

Civilizations are not self-contained organisms. Modern man could not have found his own particular modes of thought or invented his present technical equipment without drawing freely on the cultures that had preceded him or that continued to develop about him.

Each great differentiation in culture seems to be the outcome, in fact, of a process of syncretism. Flinders Petrie, in his discussion of Egyptian civilization, has shown that the admixture which was necessary for its development and fulfillment even had a racial basis; and in the development of Christianity it is plain that the most diverse foreign elements—a Dionysian earth myth, Greek philosophy, Jewish Messianism, Mithraism, Zoroastrianism—all played a part in giving the specific content and even the form to the ultimate collection of myths and offices that became Christianity.

Before this syncretism can take place, the cultures from which the elements are drawn must either be in a state of dissolution, or sufficiently remote in time or space so that single elements can be extracted from the tangled mass of real institutions. Unless this condition existed the elements themselves would not be free, as it were, to move over toward the new pole. Warfare acts as such an agent of dissociation, and in point of time the mechanical renascence of Western Europe was associated with the shock and stir of the Crusades. For what the new civilization picks up is not the complete forms and institutions of a solid culture, but just those fragments that can be transported and transplanted: it uses inventions, patterns, ideas, in the way that the Gothic builders in England used the occasional stones or tiles of the Roman villa in combination with the native flint and in the entirely different forms of a later architecture. If the villa had still been standing and occupied, it could not have been conveniently quarried. It is the death of the original form, or rather, the remaining life in the ruins, that permits the free working over and integration of the elements of other cultures.

One further fact about syncretism must be noted. In the first stages of integration, before a culture has set its own definite mark upon the materials, before invention has crystallized into satisfactory habits and routine, it is free to draw upon the widest sources. The beginning and the end, the first absorption and the final spread and conquest, after the cultural integration has taken place, are over a worldwide realm.

These generalizations apply to the origin of the present-day machine civilization: a creative syncretism of inventions, gathered from the technical debris of other civilizations, made possible the new mechanical body. The waterwheel, in the form of the Noria, had been used by the Egyptians to raise water, and perhaps by the Sumerians for other purposes; certainly in the early part of the Christian era watermills had become fairly common in Rome. The windmill perhaps came from Persia in the eighth century. Paper, the magnetic needle, gunpowder, came from China, the first two by way of the Arabs: algebra came from India through the Arabs, and chemistry and physiology came via the Arabs, too, while geometry and mechanics had their origins in pre-Christian Greece. The steam engine owed its conception to the great inventor and scientist, Hero of Alexandria: it was the translations of his works in the sixteenth century that turned attention to the possibilities of this instrument of power.

In short, most of the important inventions and discoveries that served as the nucleus for further mechanical development, did not arise, as Spengler would have it, out of some mystical inner drive of the Faustian soul: they were wind-blown seeds from other cultures. After the tenth century in Western Europe the ground was, as I have shown, well plowed and harrowed and dragged, ready to receive these seeds; and while the plants themselves were growing, the cultivators of art and science were busy keeping the soil friable. Taking root in medieval culture, in a different climate and soil, these seeds of the machine sported and took on new forms: perhaps, precisely because they had *not* originated in Western Europe and had no natural enemies there, they grew as rapidly and gigantically as the Canada thistle when it made its way onto the South American pampas. But at no point—and this is the important thing to remember—did the machine represent a complete break. So far from being unprepared for in human history, the modern machine age cannot be understood except in terms of a very long and diverse preparation. The notion that a handful of British inventors suddenly made the wheels hum in the eighteenth century is too crude even to dish up as a fairy tale to children.

The technological complex

Looking back over the last thousand years, one can divide the development of the machine and the machine civilization into three successive but *over-lapping and interpenetrating phases:* eotechnic, paleotechnic, neotechnic. The demonstration that industrial civilization was not a single whole, but showed two marked, contrasting phases, was first made by Professor Patrick Geddes and published a generation ago. In defining the paleotechnic and neotechnic phases, he however neglected the important period of preparation, when all the key inventions were either invented or foreshadowed. So, following the archeological parallel he called attention to, I shall call the first period the eotechnic phase: the dawn age of modern technics.

While each of these phases roughly represents a period of human history, it is characterized even more significantly by the fact that it forms a technological complex. Each phase, that is, has its origin in certain definite regions and tends to employ certain special resources and raw materials. Each phase has its specific means of utilizing and generating energy, and its special forms of production. Finally, each phase brings into existence particular types of workers, trains them in particular ways, develops certain aptitudes and discourages others, and draws upon and further develops certain aspects of the social heritage.

Almost any part of a technical complex will point to and symbolize a whole series of relationships within that complex. Take the various types of writing pen. The goose-quill pen, sharpened by the user, is a typical eotechnic product: it indicates the handicraft basis of industry and the close connection with agriculture. Economically it is cheap; technically it is crude, but easily adapted to the style of the user. The steel pen stands equally for the paleotechnic phase: cheap and uniform, if not durable, it is a typical product of the mine, the steel mill and of mass-production. Technically, it is an improvement upon the quill-pen; but to approximate the same adaptability it must be made in half a dozen different standard points and shapes. And finally the fountain pen—though invented as early as the seventeenth century-is a typical neotechnic product. With its barrel of rubber or synthetic resin, with its gold pen, with its automatic action, it points to the finer neotechnic economy: and in its use of the durable iridium tip the fountain pen characteristically lengthens the service of the point and reduces the need for replacement. These respective characteristics are reflected at a hundred points in the typical environment of each phase; for though the various parts of a complex may be invented at various times, the complex itself will not be *in working order* until its major parts are all assembled. Even today the neotechnic complex still awaits a number of inventions necessary to its perfection: in particular an accumulator with six times the voltage and at least the present amperage of the existing types of cell.

Speaking in terms of power and characteristic materials, the eotechnic phase is a water-and-wood complex: the paleotechnic phase is a coal-and-iron complex, and the neotechnic phase is an electricity-and-alloy complex. It was Marx's great contribution as a sociological economist to see and partly to demonstrate that each period of invention and production had its own specific value for civilization, or, as he would have put it, its own historic mission. The machine cannot be divorced from its larger social pattern; for it is this pattern that gives it meaning and purpose. Every period of civilization carries within it the insignificant refuse of past technologies and the important germs of new ones: but the center of growth lies within its own complex.

The dawn-age of our modern technics stretches roughly from the year 1000 to 1750. During this period the dispersed technical advances and suggestions of other civilizations were brought together, and the process of invention and experimental adaptation went on at a slowly accelerating pace. Most of the key inventions necessary to universalize the machine were promoted during this period; there is scarcely an element in the second phase that did not exist as a germ, often as an embryo, frequently as an independent being, in the first phase. This complex reached its climax, technologically speaking, in the seventeenth century, with the foundation of experimental science, laid on a basis of mathematics, fine manipulation, accurate timing, and exact measurement.

The eotechnic phase did not of course come suddenly to an end in the middle of the eighteenth century: just as it reached its climax first of all in Italy in the sixteenth century, in the work of Leonardo and his talented contemporaries, so it came to a delayed fruition in the America of 1850. Two of its finest products, the clipper ship and the Thonet process of making bent-wood furniture, date from the eighteen-thirties. There were parts of the world, like Holland and Denmark, which in many districts slipped directly from an eotechnic into the neotechnic economy, without feeling more than the cold shadow of the paleotechnic cloud.

With respect to human culture as a whole, the eotechnic period, though politically a chequered one, and in its later moments characterized by a deepening degradation of the industrial worker, was one of the most brilliant periods in history. For alongside its great mechanical achievements it built cities, cultivated landscapes, constructed buildings, and painted pictures, which fulfilled, in the realm of human thought and enjoyment, the advances that were being decisively made in the practical life. And if this period failed to establish a just and equitable polity in society at large, there were at least moments in the life of the monastery and the commune that were close to its dream: the afterglow of this life was recorded in More's Utopia and Andreae's Christianopolis.

Noting the underlying unity of eotechnic civilization, through all its superficial changes in costume and creed, one must look upon its successive portions as expressions of a single culture. This point is now being re-enforced by scholars who have come to disbelieve in the notion of the gigantic break supposed to have been made during the Renascence: a contemporary illusion, unduly emphasized by later historians. But one must add a qualification: namely, that with the increasing technical advances of this society there was, for reasons partly independent of the machine itself, a corresponding cultural dissolution and decay. In short, the Renascence was not, socially speaking, the dawn of a new day, but its twilight. The mechanical arts advanced as the humane arts weakened and receded, and it was at the moment when form and civilization had most completely broken up that the tempo of invention became more rapid, and the multiplication of machines and the increase of power took place.

New sources of power

At the bottom of the eotechnic economy stands one important fact: the diminished use of human beings as prime movers, and the separation of the production of energy from its application and immediate control. While the tool still dominated production energy and human skill were united within the craftsman himself: with the separation of these two elements the productive process itself tended toward a greater impersonality, and the machine-tool and the machine developed along with the new engines of power. If power machinery be a criterion, the modern industrial revolution began in the twelfth century and was in full swing by the fifteenth.

The eotechnic period was marked first of all by a steady increase in actual horsepower. This came directly from two pieces of apparatus: first, the introduction of the iron horseshoe, probably in the ninth century, a device that increased the range of the horse, by adapting him to other regions besides the grasslands, and added to his effective pulling power by giving his hoofs a grip. Second: by the tenth century the modern form of harness, in which the pull is met at the shoulder instead of at the neck, was re-invented in Western Europe—it had existed in China as early as 200 B.C.—and by the twelfth century, it had supplanted the inefficient harness the Romans had known. The gain was a considerable one, for the horse was not merely a useful aid in agriculture or a means of transport: he became likewise an improved agent of mechanical production: mills utilizing horsepower directly for grinding corn or for pumping water came into existence all over Europe, sometimes supplementing other forms of nonhuman power, sometimes serving as the principal source. The increase in the number of horses was made possible, again, by improvements in agriculture and by the opening up of the hitherto sparsely cultivated or primeval forest areas in northern Europe. This created a condition somewhat similar to that which was repeated in America during the pioneering period: the new colonists, with plenty of land at their disposal, were lacking above all in labor power, and were compelled to resort to ingenious labor-saving devices that the better settled regions in the south with their surplus of labor and their easier conditions of living were never forced to invent. This fact perhaps was partly responsible for the high degree of technical initiative that marks the period.

But while horse power ensured the utilization of mechanical methods in regions not otherwise favored by nature, the greatest technical progress came about in regions that had abundant supplies of wind and water. It was along the fast flowing streams, the Rhône and the Danube and the small rapid rivers of Italy, and in the North Sea and Baltic areas, with their strong winds, that this new civilization had its firmest foundations and some of its most splendid cultural expressions. . . .

2. THE PALEOTECHNIC PHASE

England's belated leadership

By the middle of the eighteenth century the fundamental industrial revolution, that which transformed our mode of thinking, our means of production, our manner of living, had been accomplished: the external forces of nature were harnessed and the mills and looms and spindles were working busily through Western Europe. The time had come to consolidate and systematize the great advances that had been made.

At this moment the eotechnic régime was shaken to its foundations. A new movement appeared in industrial society which had been gathering headway almost unnoticed from the fifteenth century on: after 1750 industry passed into a new phase, with a different source of power, different materials, different social objectives. This second revolution multiplied, vulgarized, and spread the methods and goods produced by the first: above all, it was directed toward the quantification of life, and its success could be gauged only in terms of the multiplication table. . . .

The new barbarism

As we have seen, the earlier technical development had not involved a complete breach with the past. On the contrary, it had seized and appropriated and assimilated the technical innovations of other cultures, some very ancient, and the pattern of industry was wrought into the dominant pattern of life itself. Despite all the diligent mining for gold, silver, lead and tin in the sixteenth century, one could not call the civilization itself a mining civilization; and the handicraftsman's world did not change completely when he walked from the workshop to the church, or left the garden behind his house to wander out into the open fields beyond the city's walls.

Paleotechnic industry, on the other hand, arose out of the breakdown of European society and carried the process of disruption to a finish. There was a sharp shift in interest from life values to pecuniary values: the system of interests which only had been latent and which had been restricted in great measure to the merchant and leisure classes now pervaded every walk of life. It was no longer sufficient for industry to provide a lifelihood: it must create an independent fortune: work was no longer a necessary part of living: it became an all-important end. Industry shifted to new regional centers in England: it tended to slip away from the established cities and to escape to decayed boroughs or to rural districts which were outside the field of regulation. Bleak valleys in Yorkshire that supplied water power, dirtier bleaker valleys in other parts of the land which disclosed seams of coal, became the environment of the new industrialism. A landless, traditionless proletariat, which had been steadily gathering since the sixteenth century, was drawn into these new areas and put to work in these new industries: if peasants were not handy, paupers were supplied by willing municipal authorities: if male adults could be dispensed with, women and children were used. These new mill villages and milltowns, barren of even the dead memorials of an older humaner culture, knew no other round and suggested no other outlet, than steady unremitting toil. The operations themselves were repetitive and monotonous; the environment was sordid; the life that was lived in these new centers was empty and barbarous to the last degree. Here the break with the past was complete. People lived and died within sight of the coal pit or the cotton mill in which they spent from fourteen to sixteen hours of their daily life, lived and died without either memory or hope, happy for the crusts that kept them alive or the sleep that brought them the brief uneasy solace of dreams.

Wages, never far above the level of subsistence, were driven down in the new industries by the competition of the machine. So low were they in the early part of the nineteenth century that in the textile trades they even for a while retarded the introduction of the power loom. As if the surplus of workers, ensured by the disfranchisement and pauperization of the agricultural workers, were not enough to re-enforce the Iron Law of Wages, there was an extraordinary rise in the birth-rate. The causes of this initial rise are still obscure; no present theory fully accounts for it. But one of the tangible motives was the fact that unemployed parents were forced to live upon the wages of the young they had begotten. From the chains of poverty and perpetual destitution there was no escape for the new mine worker or factory worker: the servility of the mine, deeply engrained in that occupation, spread to all the accessory employments. It needed both luck and cunning to escape those shackles.

Here was something almost without parallel in the history of civilization: not a lapse into barbarism through the enfeeblement of a higher civilization, but an upthrust into barbarism, aided by the very forces and interests which originally had been directed toward the conquest of the environment and the perfection of human culture. Where and under what conditions did this change take place? And how, when it represented in fact the lowest point in social development Europe had known since the Dark Ages did it come to be looked upon as a humane and beneficial advance? We must answer those questions.

The phase one here defines as paleotechnic reached its highest point, in terms of its own concepts and ends, in England in the middle of the nineteenth century: its cock-crow of triumph was the great industrial exhibition in the new Crystal Palace at Hyde Park in 1851: the first World Exposition, an apparent victory for free trade, free enterprise, free invention, and free access to all the world's markets by the country that boasted already that it was the workshop of the world. From around 1870 onwards the typical interests and preoccupations of the paleotechnic phase have been challenged by later developments in technics itself, and modified by various counterpoises in society. But like the eotechnic phase, it is still with us: indeed, in certain parts of the world, like Japan and China, it even passes for the new, the progressive, the modern, while in Russia an unfortunate residue of paleotechnic concepts and methods has helped misdirect, even partly cripple, the otherwise advanced economy projected by the disciples of Lenin. In the United States the paleotechnic régime did not get under way until the eighteen fifties, almost a century after England; and it reached its highest point at the beginning of the present century, whereas in Germany it dominated the years between 1870 and 1914, and, being carried to perhaps fuller and completer expression, has collapsed with greater rapidity there than in any other part of the world. France, except for its special coal and iron centers, escaped some of the worst defects of the period; while Holland, like Denmark and in part Switzerland, skipped almost directly from an eotechnic into a neotechnic economy, and except in ports like Rotterdam and in the mining districts, vigorously resisted the paleotechnic blight. . . .

Carboniferous capitalism

The great shift in population and industry that took place in the eighteenth century was due to the introduction of coal as a source of mechanical power, to the use of new means of making that power effective—the steam engine—and to new methods of smelting and working up iron. Out of this coal and iron complex, a new civilization developed.

Like so many other elements in the new technical world, the use of coal goes back a considerable distance in history. There is a reference to it in Theophrastus: in 320 B.C. it was used by smiths; while the Chinese not merely used coal for baking porcelain but even employed natural gas for illumination. Coal itself is a unique mineral: apart from the precious metals, it is one of the few unoxidized substances found in nature; at the same time it is one of the most easy to oxidize: weight for weight it is of course much more compact to store and transport than wood.

As early as 1234 the freemen of Newcastle were given a charter to dig for coal, and an ordinance attempting to regulate the coal nuisance in London dates from the fourteenth century. Five hundred years later coal was in general use as a fuel among glassmakers, brewers, distillers, sugar bakers, soap boilers, smiths, dyers, brickmakers, lime burners, founders, and calico printers. But in the meanwhile a more significant use had been found for coal: Dud Dudley at the beginning of the seventeenth century sought to substitute coal for charcoal in the production of iron: this aim was successfully accomplished by a Quaker, Abraham Darby, in 1709. By that invention the high-powered blast furnace became possible; but the method itself did not make its way to Coalbrookdale in Shropshire to Scotland and the North of England until the 1760's. The next development in the making of cast-iron awaited the introduction of a pump which should deliver to the furnace a more effective blast of air: this came with the invention of Watt's steam pump, and the demand for more iron, which followed, in turn increased the demand for coal.

Meanwhile, coal as a fuel for both domestic heating and power was started on a new career. By the end of the eighteenth century coal began to take the place of current sources of energy as an illuminant through Murdock's devices for producing illuminating gas. Wood, wind, water, beeswax, tallow, sperm-oil—all these were displaced steadily by coal and derivatives of coal, albeit an efficient type of burner, that produced by Welsbach, did not appear until electricity was ready to supplant gas for illumination. Coal, which could be mined long in advance of use, and which could be stored up, placed industry almost out of reach of seasonal influences and the caprices of the weather.

In the economy of the earth, the large-scale opening up of coal seams meant that industry was beginning to live for the first time on an accumulation of potential energy, derived from the ferns of the carboniferous period, instead of upon current income. In the abstract, mankind entered into the possession of a capital inheritance more splendid than all the wealth of the Indies; for even at the present rate of use it has been calculated that the present known supplies would last three thousand years. In the concrete, however, the prospects were more limited, and the exploitation of coal carried with it penalties not attached to the extraction of energy from growing plants or from wind and water. As long as the coal seams of England, Wales, the Ruhr, and the Alleghanies were deep and rich the limited terms of this new economy could be overlooked: but as soon as the first easy gains were realized the difficulties of keeping up the process became plain. For mining is a robber industry: the mine owner, as Messrs. Tryon and Eckel point out, is constantly consuming his capital, and as the surface measures are depleted the cost per unit of extracting minerals and ores becomes greater. The mine is the worst possible local base for a permanent civilization: for when the seams are exhausted, the individual mine must be closed down, leaving behind its debris and its deserted sheds and houses. The by-products are a befouled and disorderly environment; the end product is an exhausted one. . . .

The degradation of the worker

Kant's doctrine, that every human being should be treated as an end, not as a means, was formulated precisely at the moment when mechanical industry had begun to treat the worker solely as a means—a means to cheaper mechanical production. Human beings were dealt with in the same spirit of brutality as the landscape: labor was a resource to be exploited, to be mined, to be exhausted, and finally to be discarded. Responsibility for the worker's life and health ended with the cash-payment for the day's labor.

The poor propagated like flies, reached industrial maturity—ten or twelve years of age—promptly, served their term in the new textile mills or the mines, and died inexpensively. During the early paleotechnic period their expectation of life was twenty years less than that of the middle classes. For a number of centuries the degradation of labor had been going on steadily in Europe; at the end of the eighteenth century, thanks to the shrewdness and near-sighted rapacity of the English industrialists, it reached its nadir in England. In other countries, where the paleotechnic system entered later, the same brutality emerged: the English merely set the pace. What were the causes at work?

By the middle of the eighteenth century the handicraft worker had been reduced, in the new industries, into a competitor with the machine. But there was one weak spot in the system: the nature of human beings themselves: for at first they rebelled at the feverish pace, the rigid discipline, the dismal monotony of their tasks. The main difficulty, as Ure pointed out, did not lie so much in the invention of an effective self-acting mechanism as in the "distribution of the different members of the apparatus into one cooperative body, in impelling each organ with its appropriate delicacy and speed, and above all, in training human beings to renounce their desultory habits of work and to identify themselves with the unvarying regularity of the complex automaton." "By the infirmity of human nature," wrote Ure again, "it happens that the more skillful the workman, the more self-willed and intractable he is apt to become, and of course the less fit and component of the mechanical system in which . . . he may do great damage to the whole."

The first requirement for the factory system, then, was the castration of skill. The second was the discipline of starvation. The third was the closing up of alternative occupations by means of land-monopoly and dis-education.

In actual operation, these three requirements were met in reverse order. Poverty and land monopoly kept the workers in the locality that needed them and removed the possibility of their improving their position by migration: while exclusion from craft apprenticeship, together with specialization in subdivided and partitioned mechanical functions, unfitted the machine-worker for the career of pioneer or farmer, even though he might have the opportunity to move into the free lands in the newer parts of the world. Reduced to the function of a cog, the new worker could not operate without being joined to a machine. Since the workers lacked the capitalists' incentives of gain and social opportunity, the only things that kept them bound to the machine were starvation, ignorance, and fear. These three conditions were the foundations of industrial discipline, and they were retained by the directing classes even though the poverty of the worker undermined and periodically ruined the system of mass production which the new factory discipline promoted. Therein lay one of the inherent "contradictions" of the capitalist scheme of production. . . .

3. THE NEOTECHNIC PHASE

The beginnings of neotechnics

The neotechnic phase represents a third definite development in the machine during the last thousand years. It is a true mutation: it differs from the paleotechnic phase almost as white differs from black. But on the other hand, it bears the same relation to the eotechnic phase as the adult form does to the baby.

During the neotechnic phase, the conceptions, the anticipations, the imperious visions of Roger Bacon, Leonardo, Lord Verulam, Porta, Glanvill, and the other philosophers and technicians of that day at last found a local habitation. The first hasty sketches of the fifteenth century were now turned into working drawings: the first guesses were now re-enforced with a technique of verification: the first crude machines were at last carried to perfection in the exquisite mechanical technology of the new age, which gave to motors and turbines properties that had but a century earlier belonged almost exclusively to the clock. The superb animal audacity of Cellini, about to cast his difficult Perseus, or the scarcely less daring work of Michelangelo, constructing the dome of St. Peter's, was replaced by a patient co-operative experimentalism: a whole society was now prepared to do what had heretofore been the burden of solitary individuals.

Now, while the neotechnic phase is a definite physical and social complex, one cannot define it as a period, partly because it has not yet developed its own form and organization, partly because we are still in the midst of it and cannot see its details in their ultimate relationships, and partly because it has not displaced the older régime with anything like the speed and decisiveness that characterized the transformation of the eotechnic order in the late eighteenth century. Emerging from the paleotechnic order, the neotechnic institutions have nevertheless in many cases compromised with it, given way before it, lost their identity by reason of the weight of vested interests that continued to support the obsolete instruments and the anti-social aims of the middle industrial era. *Paleotechnic ideals still largely dominate the industry and the politics of the Western World:* the class struggles and the national struggles are still pushed with relentless vigor. While eotechnic practices linger on as civilizing influences, in gardens and parks and painting and music and the theater, the paleotechnic remains a barbarizing influence. To deny this would be to cling to a fool's paradise. In the seventies Melville framed a question in fumbling verse whose significance has deepened with the intervening years:

> . . . Arts are tools;
> But tools, they say, are to the strong:
> Is Satan weak? Weak is the wrong?
> No blessed augury overrules:
> Your arts advanced in faith's decay:
> You are but drilling the new Hun
> Whose growl even now can some dismay.

To the extent that neotechnic industry has failed to transform the coal-and-iron complex, to the extent that it has failed to secure an adequate foundation for its humaner technology in the community as a whole, to the extent that it has lent its heightened powers to the miner, the financier, the militarist, the possibilities of disruption and chaos have increased.

But the beginnings of the neotechnic phase can nevertheless be approximately fixed. The first definite change, which increased the efficiency of prime movers enormously, multiplying it from three to nine times, was the perfection of the water-turbine by Fourneyron in 1832. . . .

By 1850 a good part of the fundamental scientific discoveries and inventions of the new phase had been made: the electric cell, the storage cell, the dynamo, the motor, the electric lamp, the spectroscope, the doctrine of the conservation of energy. Between 1875 and 1900 the detailed application of these inventions to industrial processes was carried out in the electric power station and the telephone and the radio telegraph. Finally, a series of complementary inventions, the phonograph, the moving picture, the gasoline engine, the steam turbine, the airplane, were all sketched in, if not perfected, by 1900: these in turn effected a radical transformation of the power plant and the factory, and they had further effects in suggesting new principles for the design of cities and for the utilization of the environment as a whole. By 1910 a definite counter-march against paleotechnic methods began in industry itself.

The outlines of the process were blurred by the explosion of the World War and by the sordid disorders and reversions and compensations that followed it. Though the instruments of a neotechnic civilization are now at hand, and though many definite signs of an integration are not lacking, one cannot say confidently that a single region, much less our Western Civilization as a whole, has entirely embraced the neotechnic complex: for the necessary social institutions and the explicit social purposes requisite even for complete technological fulfillment are lacking. The gains in technics are never registered automatically in society: they require equally adroit inventions and adaptations in politics; and the careless habit of attributing to mechanical improvements a direct rôle as instruments of culture and civilization puts a demand upon the machine to which it cannot respond. Lacking a cooperative social intelligence and good-will, our most refined technics promises no more for society's improvement than an electric bulb would promise to a monkey in the midst of a jungle.

True: the industrial world produced during the nineteenth century is either technologically obsolete or socially dead. But unfortunately, its maggoty corpse has produced organisms which in turn may debilitate or possibly kill the new order that should take its place: perhaps leave it a hopeless cripple. One of the first steps, however, toward combating such disastrous results is to realize that even technically the Machine Age does not form a continuous and harmonious unit, that there is a deep gap between the paleotechnic and neotechnic phases, and that the habits of mind and the tactics we have carried over from the old order are obstacles in the way of our developing the new.

The importance of science

The detailed history of the steam engine, the railroad, the textile mill, the iron ship, could be written without more than passing reference to the scientific work of the period. For these devices were made possible largely by the method of empirical practice, by trial and selection: many lives were lost by the explosion of steam-boilers before the safety-valve was generally adopted. And though all these inventions would have been the better for science, they came into existence, for the most part, without its direct aid. It was the practical men in the mines, the factories, the machine shops and the clockmakers' shops and the locksmiths' shops or the curious amateurs with a turn for manipulating materials and imagining new processes, who made them possible. Perhaps the only scientific work that steadily and systematically affected the paleotechnic design was the analysis of the elements of mechanical motion itself.

With the neotechnic phase, two facts of critical importance become plain. First, the scientific method, whose chief advances had been in mathematics and the physical sciences, took possession of other domains of experience: the living organism and human society also became the objects of systematic investigation, and though the work done in these departments was handicapped by the temptation to take over the categories of thought, the modes of investigation, and the special apparatus of quantitative abstraction developed for the isolated physical world, the extension of science here was to have a particularly important effect upon technics. Physiology became for the nineteenth century what mechanics had been for the seventeenth: instead of mechanism forming a pattern for life, living organisms began to form a pattern for mechanism. Whereas the mine dominated the paleotechnic period, it was the vineyard and the farm and the physiological laboratory that directed many of the most fruitful investigations and contributed to some of the most radical inventions and discoveries of the neotechnic phase. . . .

Second only to the more comprehensive attack of the scientific method upon aspects of existence hitherto only feebly touched by it, was the direct application of scientific knowledge to technics and the conduct of life. In the neotechnic phase, the main initiative comes, not from the ingenious inventor, but from the scientist who establishes the general law: the invention is a derivative product. It was Henry who in essentials invented the telegraph, not Morse; it was Faraday who invented the dynamo, not Siemens; it was Oersted who invented the electric motor, not Jacobi; it was Clerk-Maxwell and Hertz who invented the radio telegraph, not Marconi and De Forest. The translation of the scientific knowledge into practical instruments was a mere incident in the process of invention. While distinguished individual inventors like Edison, Baekeland and Sperry remained, the new inventive genius worked on the materials provided by science.

Out of this habit grew a new phenomenon: deliberate and systematic invention. Here was a new material: problem—find a new use for it. Or here was a necessary utility: problem—find the theoretic formula which would permit it to be produced. The ocean cable was finally laid only when Lord Kelvin had contributed the necessary scientific analysis of the problem it presented: the thrust of the propeller shaft on the steamer was finally taken up without clumsy and expensive mechanical devices, only when Michell worked out the behavior of viscous fluids: long distance telephony was made possible only by systematic research by Pupin and others in the Bell Laboratories on the several elements in the problem. Isolated inspiration and empirical fumbling came to count less and less in invention. In a whole series of characteristic neotechnic inventions the thought was father to the wish. And typically, this thought is a collective product. . . .

New sources of energy

The neotechnic phase was marked, to begin with, by the conquest of a new form of energy: electricity. . . .

Unlike coal in long distance transportation, or like steam in local distribution, electricity is much easier to transmit without heavy losses of energy and higher costs. Wires carrying high tension alternating currents can cut across mountains which no road vehicle can pass over; and once an electric power utility is established the rate of deterioration is slow. Moreover, electricity is readily convertible into various forms: the motor, to do mechanical work, the electric lamp, to light, the electric radiator, to heat, the x-ray tube and the ultra-violet light, to penetrate and explore, and the selenium cell, to effect automatic control.

SOCIOLOGICAL

From "Technology, Nature, and Society"

DANIEL BELL

■ Daniel Bell *was born in New York City in 1919. He has been a professor of Sociology at Harvard University since 1969, and was a member of the President's Committee on Technology, Automation, and Economic Progress (1964-1966). He has received many honors and is currently a member of the editorial boards of* Daedalus *and* The American Scholar. *Among his works are* The End of Ideology *(1960) and* The Coming of Post-Industrial Society *(1973).*

Bell takes issue here with Jacques Ellul over the latter's claim that technique is autonomous (see the selection by Ellul earlier in Part Two). Bell claims that "technology, or technique, does not have a life of its own." To support his claim he introduces first a distinction between "technology" on the one hand and "the social 'support system' in which it is imbedded" on the other. Since several kinds of support systems are compatible with technology, Bell concludes that it is false to claim that technology leaves us no choices. He makes a similar distinction between technology and the accounting system that allocates costs. These observations lead Bell to conclude that the problem does not lie with technology, but rather in our ability as a society to make the right choices for that technology. (For related views on this issue, see the Autonomous Technology Debate in Part Three.)

WHAT IS SOCIETY?

The rhetoric of apocalypse haunts our times. Given the recurrence of the Day of Wrath in the Western imagination—when the seven seals are opened and the seven vials pour forth—it may be that great acts of guilt provoke fears of retribution which are projected heavenward as mighty punishments of men. A little more than a decade ago we had the apocalyptic specter (whose reality content was indeed frightening) of a nuclear holocaust, and there was a flood of predictions that a nuclear war was a statistical certainty before the end of the decade. That apocalypse has receded, and other guilts produce other fears. Today it is the ecological crisis, and we find, like the drumroll of Revelation 14 to 16 recording the plagues: *The Doomsday Book, Terracide, Our Plundered Planet, The Chasm Ahead, The Hungry Planet,* and so on.[1]

In the demonology of the time, "the great whore" is technology. It has profaned Mother Nature, it has stripped away the mysteries, it has substituted for the natural environment an artificial environment in which man cannot feel at home.[2] The modern heresy, in the thinking of Jacques Ellul, the French social philosopher whose writing has been the strongest influence in shaping this school of thought, has been to enshrine *la technique* as the ruling principle of society.

□ In *Technology and the Frontiers of Knowledge*, The Frank Nelson Doubleday Lectures—1972-73 (New York: Doubleday & Company, Inc., 1975), pp. 60-66.

Ellul defines technique as:

> the translation into action of man's concern to master things by means of reason, to account for what is subconscious, make quantitative what is qualitative, make clear and precise the outlines of nature, take hold of chaos and put order into it.

Technique, by its power, takes over the government:

> Theoretically our politicians are at the center of the machinery, but actually they are being progressively eliminated by it. Our statesmen are important satellites of the machine, which, with all its parts and techniques, apparently functions as well without them.

Technique is a new morality which "has placed itself beyond good and evil and has such power and autonomy [that] it in turn has become the judge of what is moral, the creator of a new morality." We have here a new demiurge, an "unnatural" and "blind" logos that in the end enslaves man himself:

> When technique enters into the realm of social life, it collides ceaselessly with the human being. . . . Technique requires predictability and, no less, exactness of prediction. It is necessary, then, that technique prevail over the human being. For technique, this is a matter of life and death. Technique must reduce man to a technical animal, the king of the slaves of technique.[3]

Ellul has painted a reified world in which *la technique* is endowed with anthropomorphic and demonological attributes. (Milton's Satan, someone remarked, is Prometheus with Christian theology.) Many of the criticisms of technology today remind one of Goethe, who rejected Newton's optics on the ground that the microscope and telescope distorted the human scale and confused the mind. The point is well taken, if there is confusion of realms. What the eye can see unaided, and must respond to, is different from the microcosm below and the macrocosm beyond. Necessary distinctions have to be maintained. The difficulty today is that it is the critics of technology who absolutize the dilemmas and have no answers, short of the apocalyptic solutions that sound like the familiar comedy routine "Stop the world, I want to get off."

Against such cosmic anguish one feels almost apologetic for mundane answers. But after the existentialist spasm, there remain the dull and unyielding problems of ordinary, daily life. The point is that technology, or technique, does not have a life of its own. There is no immanent logic of technology, no "imperative" that must be obeyed. Ellul has written: "Technique is a means with a set of rules for the game. . . . There is but one method for its use, one possibility."[4]

But this is patently not so if one distinguishes between technology and the social "support system" in which it is embedded.[5] The automobile and the highway network form a technological system; the way this system is used is a question of social organization. And the relation between the two can vary considerably. We can have a social system that emphasizes the private use of the automobile; money is then spent to provide parking and other facilities necessary to that purpose. On the other hand, arguing that an automobile is a capital expenditure whose "down time" is quite large, and that twenty feet of street space for a single person in one vehicle is a large social waste, we could penalize private auto use and have only a rental and taxi system that would substantially reduce the necessary number of cars. The same technology is compatible with a variety of social organizations, and we choose the one we want to use.

One should also distinguish between technology and the accounting system that allocates costs. Until recently, the social costs generated by different technologies have not been borne by the individuals or firms responsible for them, because the criterion of social accountability was not used. Today that is changing. The technology of the internal-combustion engine is being modified because the government now insists that the pollution it generates be reduced. And the technology is being changed. The energy crisis we face is less a physical shortage than the result of new demands—by consumers, and by socially minded individuals for a different kind of technological use of fuels. If we could burn the high-sulphur fuels used until a few years ago, there would be less of an energy crisis; but there would be more pollution. Here, too, the problem is one of costs and choice.

The source of our predicament is not the "imperatives" of technology but a lack of decision mechanisms for choosing the kinds of technology and social support patterns we want. The venerated teacher of philosophy at City College Morris Raphael Cohen used to pose a question to his students in moral philosophy: If a Moloch God were to offer the human race an invention that would enormously increase each individual's freedom and mobility, but demanded the human sacrifice of thirty-thousand lives (the going price at the time), would you take it? That invention, of course, was the automobile. But we had no mechanisms for assessing its effects and planning for the control of its use. Two hundred years ago, no one "voted" for our present industrial system, as men voted for a polity or a constitution. To this extent, the phrase "the industrial revolution" is deceptive, for there was no single moment when people could decide, as they did politically in 1789 or 1793 or 1917, for or against the new system. And yet today, with our increased awareness of alternates and consequences, we are beginning to make those choices. We can do this by technology assessment, and by social policy which either penalizes or encourages a technological development (e.g., the kind of energy we use) through the mechanism of taxes and subsidy.

A good deal of our intellectual difficulty stems from the way we conceive of society. Émile Durkheim, one of the founding fathers of modern sociology, contributed to this difficulty by saying that society exists *sui generis,* meaning that it could not be reduced to psychological factors. In a crucial sense he was right, but in his formulation he pictured society as an entity, a collective conscience outside the individual, acting as an external constraint on his behavior. And this lent itself to the romantic dualism of the individual versus society.

Society is *sui generis,* a level of complex organizations created by the degree of interdependence and the multiplicity of ties among men.

A traffic jam, as Thomas Schelling has pointed out, is best analyzed not in terms of the individual pathologies of the drivers, but by considering the layout of roads, the pattern of flow into and out of the city, the congestion at particular times because of work scheduling, and so on. Society is not some external artifact, but *a set of social arrangements, created by men,* to regulate normatively the exchange of wants and satisfactions.

The order of society differs from the order of nature. Nature is "out there," without *telos,* and men must discern its binding and constraining laws to refit the world. Society is a moral order, defined by consciousness and purpose, and justified by its ability to satisfy men's needs, material and transcendental. Society is a design that, as men become more and more conscious of its consequences and effects, is subject to reordering and rearrangement in the effort to solve its quandaries. It is a social contract, made not in the past but in the present, in which the constructed rules are obeyed if they seem fair and just.

The problems of modern society arise from its increasing complexity and interdependence—the multiplication of interaction and the spread of syncretism—as old segmentations break down and new arrangements are needed. The resolution of the problem is twofold: to create political and administrative structures that are responsive to the new scales, and to develop a more comprehensive or coherent creed that diverse men can share. The prescription is easy. It is the exegesis, as the listener to Rabbi Hillel finally understood, that is difficult.[6]

NOTES

1. The temper is not restricted to ecologists. Alfred Kazin cites the titles of some recent cultural-social analyses of "our situation": *Reflections on a Sinking Ship, Waiting for the End, The Fire Next Time, The Economy of Death, The Sense of an Ending, On the Edge of History, Thinking About the Unthinkable.*
2. Theodore Roszak, for example, writes: ". . . we must not ignore the fact that there *is* a natural environment—the world of wind and wave, beast and flower, sun and stars—and that preindustrial people lived for millennia in close company with that world, striving to harmonize the things and thoughts of their own making with its non-human forces. Circadian and seasonal rhythms were the first clock people knew, and it was by co-ordinating these fluid organic cycles with their own physiological tempos that they timed their activities. What they ate, they had killed or cultivated with their own hands, staining them with the blood or dirt of their effort. They learned from the flora and fauna of their surroundings, conversed with them, worshiped them, and sacrificed to them. They were convinced that their fate was bound up intimately with these non-human friends and foes, and in their culture they made place for them, honoring their ways."

   What is striking in this evocation of a pagan idyl is the complete neglect of the diseases which wasted most "natural" men, the high infant mortality, the painful, frequent childbirths which debilitated the women, and the recurrent shortages of food and the inadequacies of shelter which made life nasty, brutish, and short.
3. Jacques Ellul, *The Technological Society* (Knopf, New York, 1964), Chapter II, *passim.* What is striking in this unsparing attack on technique is Ellul's omission of any discussion of nature, or how man must live without technique. (The word *nature* does not appear in the index, and there are only a few passing references to the natural world, e.g., p. 79.) As Ellul's translator, John Wilkinson, writes in the Introduction: "In view of the fact that Ellul continually apostrophizes technique as 'unnatural' (except when he calls it the 'new nature'), it might be thought surprising that he has no fixed conception of nature or the natural. The best answer seems to be that he considers 'natural' (in the good sense) *any* environment able to satisfy man's material needs, *if* it leaves him free to use it as means to achieve his individual internally generated ends." Ibid., p. xix.
4. Ibid., p. 97.
5. The distinction is made in the report of the National Academy of Sciences, *Technology: Processes of Assessment and Choice,* published by the Committee on Science and Astronautics, U.S. House of Representatives, July 1969. See p. 16.
6. The traditional story is told that an impatient man once asked Rabbi Hillel to tell him all there was in Judaism while standing on one foot. The Rabbi pondered, and replied: "Do *not* do unto others as you would *not* have them do unto you. All the rest is exegesis."

POLITICAL-ECONOMIC

From "The Problem"

HENRY GEORGE

▪ Henry George *(1839-1897) was born in Philadelphia. He was a well-known American writer, economist, and philosopher. In Dewey's words, "It would require less than the fingers of the two hands to enumerate those who, from Plato down, rank with Henry George among the world's social philosophers." Nevertheless, he is not presently acknowledged as such among philosophers. His main goal as a journalist, writer, and philosopher was to criticize and expose some of the major inequities of his day. His major work is* Progress and Poverty *(1879), from which this selection is taken.*

Henry George is disappointed with technological progress. Speaking of the introduction of machinery to factories, he says "it was natural to expect . . . that labor-saving inventions would lighten the toil and improve the condition of the laborer." But this expectation, along with many others, was dashed. Instead "we find the deepest poverty, the sharpest struggle for existence, and the most of enforced idleness." Technological progress, instead of alleviating human misery, has contributed to it. Thus he finds himself forced to conclude that "social difficulties existing wherever a certain stage of progress has been reached, do not arise from local circumstances, but are, in some way or another, engendered by progress itself." In this statement Henry George is in disagreement with Daniel Bell, among others (see preceding selection in Part Two). He seems to be accepting a form of technological determinism.

The present century has been marked by a prodigious increase in wealth-producing power. The utilization of steam and electricity, the introduction of improved processes and labor-saving machinery, the greater subdivision and grander scale of production, the wonderful facilitation of exchanges, have multiplied enormously the effectiveness of labor.

At the beginning of this marvelous era it was natural to expect, and it was expected, that labor-saving inventions would lighten the toil and improve the condition of the laborer; that the enormous increase in the power of producing wealth would make real poverty a thing of the past. Could a man of the last century—a Franklin or a Priestley—have seen, in a vision of the future, the steamship taking the place of the sailing vessel, the railroad train of the wagon, the reaping machine of the scythe, the threshing machine of the flail; could he have heard the throb of the engines that in obedience to human will, and for the satisfaction of human desire, exert a power greater than that of all the men and all the beasts of burden of the earth combined; could he have seen the forest tree transformed into finished lumber—into doors, sashes, blinds, boxes or barrels, with hardly the touch of a human hand; the great workshops where boots and shoes are turned out by the case with less labor than the old-fashioned cobbler could have put on a sole; the factories where, under the eye of a girl, cotton becomes cloth faster than hundreds of stalwart weavers could have turned it out with their handlooms; could he have seen steam hammers shaping mammoth shafts and mighty anchors, and delicate machinery making tiny watches; the diamond drill cutting through the heart of the rocks, and coal oil sparing the whale; could he have realized the enormous saving of labor resulting from improved facilities of exchange and communication—sheep killed in Australia eaten fresh in England, and the order given by the London banker in the afternoon executed in San Francisco in the morning of the same day; could he have conceived of the hundred thousand improvements which these only suggest, what would he have inferred as to the social condition of mankind?

It would not have seemed like an inference; further than the vision went it would have seemed as though he saw; and his heart would have leaped and his nerves would have thrilled, as one who from a height beholds just ahead of the thirst-stricken caravan the living gleam of rustling woods and the glint of laughing waters. Plainly, in the sight of the imagination, he would have beheld these new forces elevating society from its very foundations, lifting the very poorest above the possibility of want, exempting the very lowest from anxiety for the material needs of life; he would have seen these slaves of the lamp of knowledge taking on themselves the traditional curse, these muscles of iron and sinews of steel making the poorest

☐ From *Progress And Poverty* (New York: The Modern Library, 1938), pp. 3-8.

laborer's life a holiday, in which every high quality and noble impulse could have scope to grow.

And out of these bounteous material conditions he would have seen arising, as necessary sequences, moral conditions realizing the golden age of which mankind have always dreamed. Youth no longer stunted and starved; age no longer harried by avarice; the child at play with the tiger; the man with the muck-rake drinking in the glory of the stars. Foul things fled, fierce things tame; discord turned to harmony! For how could there be greed where all had enough? How could the vice, the crime, the ignorance, the brutality, that spring from poverty and the fear of poverty, exist where poverty had vanished? Who should crouch where all were freemen; who oppress where all were peers?

More or less vague or clear, these have been the hopes, these the dreams born of the improvements which give this wonderful century its preëminence. They have sunk so deeply into the popular mind as radically to change the currents of thought, to recast creeds and displace the most fundamental conceptions. The haunting visions of higher possibilities have not merely gathered splendor and vividness, but their direction has changed—instead of seeing behind the faint tinges of an expiring sunset, all the glory of the daybreak has decked the skies before.

It is true that disappointment has followed disappointment, and that discovery upon discovery, and invention after invention, have neither lessened the toil of those who most need respite, nor brought plenty to the poor. But there have been so many things to which it seemed this failure could be laid, that up to our time the new faith has hardly weakened. We have better appreciated the difficulties to be overcome; but not the less trusted that the tendency of the times was to overcome them.

Now, however, we are coming into collision with facts which there can be no mistaking. From all parts of the civilized world come complaints of industrial depression; of labor condemned to involuntary idleness; of capital massed and wasting; of pecuniary distress among business men; of want and suffering and anxiety among the working classes. All the dull, deadening pain, all the keen, maddening anguish, that to great masses of men are involved in the words "hard times," afflict the world to-day. This state of things, common to communities differing so widely in situation, in political institutions, in fiscal and financial systems, in density of population and in social organization, can hardly be accounted for by local causes. There is distress where large standing armies are maintained, but there is also distress where the standing armies are nominal; there is distress where protective tariffs stupidly and wastefully hamper trade, but there is also distress where trade is nearly free; there is distress where autocratic government yet prevails, but there is also distress where political power is wholly in the hands of the people; in countries where paper is money, and in countries where gold and silver are the only currency. Evidently, beneath all such things as these, we must infer a common cause.

That there is a common cause, and that it is either what we call material progress or something closely connected with material progress, becomes more than an inference when it is noted that the phenomena we class together and speak of as industrial depression are but intensifications of phenomena which always accompany material progress, and which show themselves more clearly and strongly as material progress goes on. Where the conditions to which material progress everywhere tends are most fully realized—that is to say, where population is densest, wealth greatest, and the machinery of production and exchange most highly developed—we find the deepest poverty, the sharpest struggle for existence, and the most of enforced idleness.

It is to the newer countries—that is, to the countries where material progress is yet in its earlier stages—that laborers emigrate in search of higher wages, and capital flows in search of higher interest. It is in the older countries—that is to say, the countries where material progress has reached later stages—that widespread destitution is found in the midst of the greatest abundance. Go into one of the new communities where Anglo-Saxon vigor is just beginning the race of progress; where the machinery of production and exchange is yet rude and inefficient; where the increment of wealth is not yet great enough to enable any class to live in ease and luxury; where the best house is but a cabin of logs or a cloth and paper shanty, and the richest man is forced to daily work—and though you will find an absence of wealth and all its concomitants, you will find no beggars. There is no luxury, but there is no destitution. No one makes an easy living, nor a very good living; but every one *can* make a living, and no one able and willing to work is oppressed by the fear of want.

But just as such a community realizes the conditions which all civilized communities are striving for, and advances in the scale of material progress—just as closer settlement and a more intimate connection with the rest of the world, and greater utilization of labor-saving machinery, make possible greater economies in production and exchange, and wealth in consequence increases, not merely in the aggregate, but in proportion to population—so does poverty take a darker aspect. Some get an infinitely better and easier living, but others find it hard to get a living at all. The "tramp" comes with the locomotive, and almshouses and prisons are as surely the marks of "material progress" as are costly dwellings, rich warehouses, and magnificent churches. Upon streets lighted with gas and patrolled by uniformed policemen, beggars wait for the passer-by, and in the shadow of college, and library, and museum, are gathering the more hideous Huns and fiercer Vandals of whom Macaulay prophesied.

This fact—the great fact that poverty and all its concomitants show themselves in communities just as they develop into the conditions toward which material progress tends—proves that the social difficulties existing wherever a certain stage of progress has been reached, do not arise from local circumstances, but are, in some way or another, engendered by progress itself.

And, unpleasant as it may be to admit it, it is at last becoming evident that the enormous increase in productive power which has marked the present century and is still going on with accelerating ratio, has no tendency to extirpate poverty or to lighten the burdens of those compelled to toil. It simply widens the gulf between Dives and Lazarus, and makes the struggle for existence more intense. The march of invention has clothed mankind with powers of which a century ago the boldest imagination could not have dreamed. But in factories where labor-saving machinery has reached its most wonderful development, little children are at work; wherever the new forces are anything like fully utilized, large classes are maintained by charity or live on the verge of recourse to it; amid the greatest accumulations of wealth, men die of starvation, and puny infants suckle dry breasts; while everywhere the greed of gain, the worship of wealth, shows the force of the fear of want. The promised land flies before us like the mirage. The fruits of the tree of knowledge turn as we grasp them to apples of Sodom that crumble at the touch.

POLITICAL-ECONOMIC

From "Technology, Planning and Organization"

JOHN KENNETH GALBRAITH

■ John Kenneth Galbraith *was born in Ontario, Canada, in 1908. He was educated in Canada, the United States, and England. He taught at Harvard, and in 1959 became the Paul M. Warburg Professor of Economics there. He retired in 1975. Galbraith is the recipient of many awards and honors, and has written several books. Among his books are* The New Industrial State *(1967) and* The Age of Uncertainty *(1977).*

In the essay reprinted in part here, Galbraith traces recent shifts of power in Western societies. During feudal times, Galbraith argues, land was the source of power, for agricultural production then accounted for a large share of all production, and "power to engage in agricultural production rested with land ownership." Furthermore, "to get more land was difficult, and lost land was, as likely as not, irreplaceable."

But with the Industrial Revolution and the discovery of "a munificent supply" of land in the last century, land was dethroned by capital. "The man who owned or supplied the capital now had the strategically important factor of production. Authority over the enterprise, as a result, now passed to him."

Galbraith claims that a third shift of power is taking place in modern society. "Modern economic society can only be understood as an effort, notably successful, to synthesize, by organization, a personality far superior for its purposes to a natural person and with the added advantage of immortality." As a result of this new state of affairs, power has shifted from capital to management, since the latter is now in greater demand than the former.

In the last three decades, evidence has been accumulating of a shift of power from owners to managers within the modern large corporation. The power of the stockholders has seemed increasingly tenuous. A few stockholders assemble in an annual meeting, and a much larger number return proxies, ratifying the decisions of the management including its choices for the Board of Directors to speak for stockholders. So long, at least, as it makes profits—in 1964 none of the largest 100 industrial corporations and only seven of the largest 500 lost money—the position of a management is impregnable. The stockholders are literally powerless. To most economists, as to most lawyers, this whole tendency has seemed of questionable legitimacy. Some, in accordance with the established reaction to seemingly inconvenient truth, have sought to maintain the myth of stockholder power. Others, including all Marxians, have argued that the change is superficial, that capital retains a deeper and more functional control. Some have conceded the change but have deferred judgment as to its significance.[1] Yet others have seen a possibly dangerous usurpation of the legitimate power of capital.[2] No one (of whom I am aware) has questioned the credentials of capital, where power is concerned, or suggested that it might be *durably* in eclipse. If there is power, it was meant to have it.

Yet, over a longer range of time, power over the productive enterprise—and by derivation in the society at large—has shifted radically as between factors of production. The eminence of capital is a relatively recent matter; until about two centuries ago no qualified observer would have doubted that the decisive factor of production was land. The wealth, military power and the sanguinary authority over life and liberty of others that went with land ownership assured its possessor of a position of eminence in his community and of power in the state. These perquisites of land ownership also gave a strong and even controlling direction to history. For the great span of 250 years, until about a hundred years before the discovery of America, it helped inspire the recurrent military campaigns to the East which are called the Crusades. Succor for Byzantium, which was beset by the infidels and redemption of Jerusalem, which had been lost to them, served, without doubt, as a stimulant to religious ardor. But the younger sons of the Frankish nobility badly needed land. Beneath the mantled cross beat hearts soundly attuned to the value of real estate. Baldwin, younger brother of Godfrey of Bouillon, found himself faced on the way to the Holy City with the taxing decision as to whether to continue with the redeeming armies or take up an attractive piece of property at Edessa. He unhesitatingly opted for the latter and, only on the death of his brother, did he leave his fief to become the first King of Jerusalem.

☐ From *Values and the Future*, ed. Kurt Baier and Nicholas Rescher (New York: The Free Press, 1969), pp. 355-364.

For four centuries following the discovery of America, appreciation of the strategic role of land gave it an even greater role in history. The Americas were populated—as also the Steppes and the habitable parts of the Antipodes. Once again religion went hand in hand with real property conveyancing, somewhat disguising the role of the latter. Spaniards considered themselves commissioned by God to win the souls of Indians; Puritans believed themselves primarily under obligation to look after their own. For Catholics and Cavaliers the Lord was believed to favor rather large acreages with the opportunity these accorded for custody of (and useful labor by) the aborigines and, as these gave out, of Africans. For Puritans, and Protestants generally, merit lay with the homestead and family farm. But these were details. In the New World, as in the Old, it was assumed that power and responsibility belonged, as right, to men who owned land. Democracy, in its modern meaning, began as a system which gave the suffrage to each and every person who owned land—and to no others.

The economic foundations of this eminence of land, and the incentive to its acquisition, were exceedingly firm. Until comparatively modern times, agricultural production—the provision of food and fiber—accounted for a large share of all production as it still accounts for 70-80 percent of output in countries such as India today. Subject to such rights as law and custom accorded to subordinate tenure, power to engage in agricultural production rested with land ownership. This, *pro tanto,* was power over a very large share of all economic activity.

The other factors of production were not of decisive importance. Agricultural technology was stable and made small use of mechanical power or other capital equipment. Thus a sparse supply of capital was matched, an important but sometimes neglected point, until a couple of hundred years ago by an equally meager opportunity for its use. If implements, work, stock or seed were lost this was not decisive; the modest requirements could be replaced.

The same was true of labor. Its historical tendency had been to keep itself in a condition of comparative abundance. David Ricardo, having regard for experience to that time, could hold in 1817 that "no point is better established than that the supply of labourers will always ultimately be in proportion to the means of supporting them."[3] This was to say that all that might be required would be forthcoming at, or about, the subsistence wage. The labor supply could be easily increased or replaced. But to get more land was difficult, and lost land was, as likely as not, irreplaceable. So land was strategic and not even the philosophers whose ideas ushered in the Industrial Revolution—Smith, and especially Ricardo and Malthus—could envisage a society where this was otherwise.

Then in the last century, in what we all agree to call the advanced countries, land was dethroned. The search for land, set in motion by its strategic role, uncovered a munificent supply. The Americas, Russia, South Africa and Australia were all discovered to have a large, unused and usable supply.

Meanwhile, mechanical inventions and the growth of metallurgical and engineering knowledge were prodigiously expanding opportunities for the employment of capital. From this greater use of capital came greater production and from that production came greater income and savings. It is not clear that in the last century the demand for capital grew more rapidly than the supply. In the new countries, including the United States, capital was generally scarce and the cost was high. In England, however, over most of the century, interest rates were low. But a diminishing proportion of the expanding production was of agricultural products and hence dependent on land. Iron and steel, ships, locomotives, textile machinery, buildings and bridges increasingly dominated the national product. For producing these, command of capital, not land, was what counted. Labor continued to be abundant in most places. Accordingly, the man who owned or supplied the capital now had the strategically important factor of production. Authority over the enterprise, as a result, now passed to him.

So did prestige in the community and political power. At the beginning of the nineteenth century the British Parliament was still dominated by the landed great; by the end of the century its premier figure was the Birmingham industrialist and pioneer screw manufacturer Joseph Chamberlain. At the beginning of the century, the United States government was dominated by the Virginia gentlemen; by the end of the century it was profoundly influenced by—depending on one's point of view—the men of enterprise or the malefactors of great wealth. The Senate was called a rich man's club.

This change, a point of much importance for what I am about to say, did not seem natural. George Washington, Thomas Jefferson, and James Madison seemed appropriate to the positions of public power. Public influence exercised by Jay Gould, Collis P. Huntington, J. P. Morgan, Elbert H. Gary, and Andrew Mellon seemed more suspect. The landowners were credited with capacity for action apart from their own interests and action in their own interest—the defense, for example, of slavery—seemed somehow legitimate. The capitalists were not credited with action apart from interest and their interest seemed less legitimate. This contrasting impression has not yet been exorcised from public attitudes or the elementary history books. We may lay it down as a rule that the older the exercise of any power the more benign it will appear and the more recent its assumption the more dangerous it will seem.

While capital in the last century was not scarce, at least in the great industrial centers, it was not in surplus. But in the present day economy, capital is, under most circumstances, abundant. The central task of modern economic policy, as it is most commonly defined, is to insure that all intended savings, at a high level of output, are offset by investment. This is what we have come to call Keynesian economic policy. Failure to invest all savings means unemployment—an excess of labor. So capital and labor have a conjoined tendency to abundance.

Back of this tendency of savings to surplus is a society which, increasingly, emphasizes not the need for frugality but the need for consumption. Saving, so far from being painful, reflects a failure in efforts by industry and the state to promote adequate consumption. Saving is also the product of a strategy by which the industrial enterprise seeks to insure full control of its sources of capital supply and thus to make its use a matter of internal decision. It is an effort which enjoys great success. Nearly three-quarters of capital investment last year was derived from the internal savings of corporations.

Capital, like land before it, owed its power over the enterprise to the difficulty of replacement or addition at the margin. What happens to that power when supply is not only abundant but excessive, when it is a central aim of social policy to offset savings and promote consumption and when it is a basic and successful purpose of business enterprises to exercise the control over the supply of capital that was once the foundation of its authority?

The plausible answer is that it will lose its power to a more strategic factor—one with greater bargaining power at the margin—if there is one. And there is.

Power has passed to what anyone in search of novelty might be forgiven for characterizing as a new factor of production. This is the structure of organization which combines and includes the technical knowledge, talent and experience that modern industrial technology and planning require. This structure is the creature of the modern industrial system and of its technology and planning. It embraces engineers, scientists, sales and advertising specialists, other technical and specialized talent—as well as the conventional leadership of the industrial enterprise. It is on the effectiveness of this structure, as indeed most business doctrine now implicity agrees, that the success of the business enterprise now depends. It can be created or enlarged only with difficulty. In keeping with past experience, the problem of supply at the margin accords *it* power.

The new recipients of power, it will be clear, are not individuals; the new locus of power is collegial or corporate. This fact encounters almost instinctive resistance. The individual has far more standing in our formal culture than the group. An individual has a presumption of accomplishment; a committee has a presumption of inaction. Individuals have souls; corporations are notably soulless. The entrepreneur—individualistic, restless, equipped with vision, guile, and courage—has been the economists' only hero. The great business organization arouses no similar affection. Admission to the economists' heaven is individually and by families; it is not clear that the top management even of an enterprise with an excellent corporate image can yet enter as a group. To be required, in pursuit of truth, to assert the superiority of the group over the individual for important social tasks is a taxing prospect.

Yet it is a necessary task. Modern economic society can only be understood as an effort, notably successful, to synthesize, by organization, a personality far superior for its purposes to a natural person and with the added advantage of immortality.

The need for such synthetic personality begins *first* with the fact that in modern industry a large number of decisions, and *all* that are important, require information possessed by more than one man. All important decisions draw on the specialized scientific and technical knowledge; on the accumulated information or experience; and on the artistic or intuitive reaction of several or many persons. The final decision will be informed only as it draws on all whose information is relevant. And there is the further important requirement that this information must be properly weighed to assess its relevance and its reliability. There must be, in other words, a mechanism for drawing on the information of numerous individuals and for measuring the importance and testing the reliability of what each has to offer.

The need to draw on the information of numerous individuals derives first from the *technological* requirements of modern industry. These are not always inordinately sophisticated; a man of moderate genius could, quite conceivably, provide himself with the knowledge of the various branches of metallurgy and chemistry, and of engineering, procurement, production management, quality control, labor relations, styling and merchandising which are involved in the development of a modern automobile. But even moderate genius is in unpredictable supply; and to keep abreast of all the relevant branches of science, engineering, and art would be time consuming. The answer, which allows of the use of far more common talent and with greater predictability of result, is to have men who are appropriately qualified or experienced in each limited area of specialized knowledge or art. Their information is then combined for the design and production of the vehicle. It is the common public impression, greatly encouraged by scientists, engineers and industrialists, that modern scientific, engineering and industrial achievements are the work of a new and quite remarkable race of men. This is pure vanity. The real accomplishment is in taking ordinary men, informing them narrowly but deeply and then devising an organization which combines their knowledge with that of other similarly specialized but equally ordinary men for a highly predictable performance.

The *second* factor requiring the combination of specialized talent derives from large-scale employment of capital in combination with sophisticated technology. This makes imperative planning and accompanying control of environment. The market is, in remarkable degree, an intellectually undemanding institution. The Wisconsin farmer need not anticipate his requirements for fertilizers, pesticides or even machine parts; the market stocks and supplies them. The cost is the same for the farmer of intelligence and the neighbor who under medical examination shows daylight in either ear. There need be no sales strategy; the market takes all his milk at the ruling price. Much of the appeal of the market, to economists at least, has been the way it seems to simplify life.

The extensive use of capital, with advanced technology, greatly reduced the power of the market. Planning, with attendent complexity of task, takes its place. Thus the manufacturer of missiles, space vehicles or modern aircraft must foresee and insure his requirements for specialized plant, specialized talent, arcane materials and intricate components. These the market cannot be counted upon to supply. And there is no open market where these products can be sold. Everything depends on the care with which contracts are sought and nurtured, in Washington. The same complexities hold in only lesser degree for the maker of automobiles, processed foods and detergents. This firm too must foresee requirements and manage the markets for its products. All such planning is dealt with only by highly-qualified men—men who can foresee need and insure the supply of production requirements, relate costs to an appropriate price strategy, see that customers are suitably persuaded to buy what is made available and, at yet higher levels of technology and complexity, see that the state is persuaded.

Technology and planning thus require the extensive combination and testing of information. Much of this is accomplished, in practice, by men talking with each other—by meeting in committee. One can do worse than think of a business organization as a complex of committees. Management consists in recruiting and assigning talent to the right committee, in intervening on occasion to force a decision, and in either announcing the decision or carrying it, as a datum, for a yet larger decision by the next committee.

It must not be supposed that this is an inefficient device. A committee allows men to pool information under circumstances that allow also of immediate probing and discussion to assess the relevance and reliability of the information offered. Loose or foolish talk, or simple uncertainty, is revealed as in no other way. There is also no doubt considerable stimulus to mental effort; men who believe themselves deeply engaged in private thought are usually doing nothing at all. Committees are condemned by those who are caught by the *cliché* that individual effort is somehow superior to group effort; by those whose suspicions are aroused by the fact that for many people group effort is more congenial and pleasant; by those who do not see that the process of extracting, and especially of testing, information has necessarily a somewhat undirected quality—briskly conducted meetings invariably decide matters that were decided beforehand elsewhere; and by those who fail to see that highly-paid men, when sitting around a table as a committee, are not necessarily wasting more time, in the aggregate, than each would waste all by himself. Forthright men frequently react to belief in their own superior capacity for decision by abolishing all committees. They then constitute working parties, task forces, operations centers or executive groups in order to avoid the truly disastrous consequences of deciding matters themselves.

This group decision-making extends deeply into the enterprise; it goes far beyond the group commonly designated as the management. Power, in fact, is *not* closely related to position in the hierarchy of the enterprise. We always carry in our minds an implicit organization chart of the business enterprise. At the top is the Board of Directors and the Board Chairman; next comes the President; next comes the Executive Vice-President; thereafter comes the Department or Divisional Heads—those who preside over the Chevrolet division, large generators, the computer division. Power is presumed to pass down from the pinnacle.

This happens only in organizations with a routine task, such, for example, as the peacetime drill of a platoon. Otherwise the power lies with the individuals who possess the knowledge. If their knowledge is particular and strategic their power becomes very great. Enrico Fermi rode a bicycle to work at Los Alamos. Leslie Groves commanded the whole Manhattan Project. It was Fermi and his colleagues, and not General Groves in his grandeur, who made the decisions of importance.

But it should not be imagined that group decision making is confined to nuclear technology and space mechanics. In our day even simple products are made or packaged or marketed by highly sophisticated methods. For these too power passes into organization. For purposes of pedagogy, I have sometimes illustrated these matters by reference to a technically uncomplicated product, which, unaccountably, neither General Electric nor Westinghouse has yet placed on the market. It is a toaster of standard performance except that it etches on the surface of the toast, in darker carbon, one of a selection of standard messages or designs. For the elegant hostess, monograms would be available, or even a coat of arms; for the devout, there would be at breakfast an appropriate devotional message from the works of Norman Vincent Peale; the patriotic, or worried, would have an aphorism urging vigilance from Mr. J. Edgar Hoover; for modern economists, there would be mathematical design; a restaurant version could sell advertising, or urge the peaceful acceptance of the integration of public eating places.

Conceivably this vision could come from the President of General Electric. But the orderly proliferation of such ideas is the established function of much more lowly men who are charged, specifically, with new product development. At an early stage in the development of the toaster, specialists in style, design and, no doubt, philosophy, art and spelling would have to be accorded a responsible role. No one in a position to authorize the product would do so without a judgment on how the problems of design and inscription were to be solved and the cost. An advance finding would be over-ridden only with caution. All action would be contingent on the work of specialists in market testing and analysis who would determine whether and by what means the toaster could be sold and at what cost for various quantities. They would function as part of a team which would also include merchandising, advertising and dealer relations men. No adverse decision by this group would be over-ruled. Nor, given the notoriety that attaches to missed opportunity, would a favorable decision. It will be evident that nearly all power—initiative, development, rejection or approval—is exercised deep down in the company.

So two great trends have converged. In consequence of advanced technology, highly capitalized production and a capacity through planning to command earnings for the use of the firm, capital has become comparatively abundant. And the imperatives of advanced technology and planning have moved the power of decision from the individual to the group and have moved it deeply into the firm.

NOTES

1. Cf. Edward S. Mason, "The Apologetics of Managerialism," *Journal of Business* (University of Chicago) January, 1958. And "Comment" in *A Survey of Contemporary Economics*, pp. 221-222.
2. Cf. Adolf A. Berle, Jr., *Power Without Property* (New York: Harcourt, Brace and Company, 1959), pp. 98 *et seq.*
3. David Ricardo, "On the Principles of Political Economy and Taxation," *The Works and Correspondence of David Ricardo*, ed. by Piero Sraffa (Cambridge, 1951), p. 292.

POLITICAL-ECONOMIC

From "America in the Technetronic Age: New Questions of Our Time"

ZBIGNIEW BRZEZINSKI

■ Zbigniew Brzezinski *was born in Warsaw, Poland, in 1928. He came to the United States in 1953, and was naturalized in 1958. He taught at Harvard University, and in 1962 became the director of the Research Institute for International Change at Columbia University. He was also a faculty member of the Russian Institute there. In 1973 he became the director of the influential Trilateral Commission, and in 1977 he became assistant to the President for national security affairs. Brzezinski has received many honors. Among his books are* Between two Ages *(1970) and* Political Power: USA/USSR *(1966).*

In "America in the Technetronic Age" Brzezinski argues that "we are entering a novel metamorphic phase in human history. The world is on the eve of a transformation more dramatic in its historical and human consequences than that wrought either by the French or the Bolshevik revolutions." Underlying this transformation are new developments in technology, particularly in the areas of computers and communications. These developments are shaping—culturally, socially, and economically—a new society which Brzezinski calls the "technetronic society." This society is substantially different from the industrial society, and Brzezinski discusses several of these differences.

Significantly, the United States is beginning to enter this new phase of human history while countries in Europe remain caught in the industrial phase and while Third World countries remain even farther behind. This state of affairs, Brzezinski argues, is reason for deep concern. He sees the gap developing among these nations as a source of international instability, and he suggests various ways for remedying the problem.

Ours is no longer the conventional revolutionary era; we are entering a novel metamorphic phase in human history. The world is on the eve of a transformation more dramatic in its historic and human consequences than that wrought either by the French or the Bolshevik revolutions. Viewed from a long perspective, these famous revolutions merely scratched the surface of the human condition. The changes they precipitated involved alterations in the distribution of power and property within society; they did not affect the essence of individual and social existence. Life—personal and organised—continued much as before, even though some of its external forms (primarily political) were substantially altered. Shocking though it may sound to their acolytes, by the year 2000 it will be accepted that Robespierre and Lenin were mild reformers.

Unlike the revolutions of the past, the developing metamorphosis will have no charismatic leaders with strident doctrines, but its impact will be far more profound. Most of the change that has so far taken place in human history has been gradual—with the great "revolutions" being mere punctuation marks to a slow, eludible process. In contrast, the approaching transformation will come more rapidly and will have deeper consequences for the way and even perhaps for the meaning of human life than anything experienced by the generations that preceded us.

America is already beginning to experience these changes and in the course of so doing it is becoming a "technetronic" society: a so-

□ *Encounter* [London], Jan. 1968, pp. 16-19, 23-26.

ciety that is shaped culturally, psychologically, socially and economically by the impact of technology and electronics, particularly computers and communications. The industrial process no longer is the principal determinant of social change, altering the mores, the social structure, and the values of society. This change is separating the United States from the rest of the world, prompting a further fragmentation among an increasingly differentiated mankind, and imposing upon Americans a special obligation to ease the pains of the resulting confrontation.

THE TECHNETRONIC SOCIETY

The far-reaching innovations we are about to experience will be the result primarily of the impact of science and technology on man and his society, especially in the developed world. Recent years have seen a proliferation of exciting and challenging literature on the future. Much of it is serious, and not mere science-fiction.[1] Moreover, both in the United States and, to a lesser degree, in Western Europe a number of systematic, scholarly efforts have been designed to project, predict, and possess what the future holds for us. Curiously very little has been heard on this theme from the Communist World, even though Communist doctrinarians are the first to claim their 19th-century ideology holds a special pass-key to the 21st century.

The work in progress indicates that men living in the developed world will undergo during the next several decades a mutation potentially as basic as that experienced through the slow process of evolution from animal to human experience. The difference, however, is that the process will be telescoped in time—and hence the shock effect of the change may be quite profound. Human conduct will become less spontaneous and less mysterious—more predetermined and subject to deliberate "programming." Man will increasingly possess the capacity to determine the sex of his children, to affect through drugs the extent of their intelligence and to modify and control their personalities. The human brain will acquire expanded powers, with computers becoming as routine an extension of man's reasoning as automobiles have been of man's mobility. The human body will be improved and its durability extended: some estimate that during the next century the average life-span could reach approximately 120 years.

These developments will have major social impact. The prolongation of life will alter our values, our career patterns, and our social relationships. New forms of social control may be needed to limit the indiscriminate exercise by individuals of their new powers. The possibility of extensive chemical mind-control, the danger of loss of individuality inherent in extensive transplantation, and the feasibility of manipulation of the genetic structure will call for a social definition of common criteria of restraint as well as of utilisation. Scientists predict with some confidence that by the end of this century, computers will reason as well as man, and will be able to engage in "creative" thought; wedded to robots or to "laboratory beings," they could act like humans. The makings of a most complex—and perhaps bitter—philosophical and political dialogue about the nature of man are self-evident in these developments.

Other discoveries and refinements will further alter society as we now know it. The information revolution, including extensive information storage, instant retrieval, and eventually push-button visual and sound availability of needed data in almost any private home, will transform the character of institutionalised collective education. The same techniques could serve to impose well-nigh total political surveillance on every citizen, putting into much sharper relief than is the case today the question of privacy. Cybernetics and automation will revolutionise working habits, with leisure becoming the practice and active work the exception—and a privilege reserved for the most talented. The achievement-oriented society might give way to the amusement-focused society, with essentially spectator spectacles (mass sports, TV) providing an opiate for increasingly purposeless masses.

But while for the masses life will grow longer and time will seem to expand, for the activist élite time will become a rare commodity. Indeed, even the élite's sense of time will alter. Already now speed dictates the pace of our lives—instead of the other way around. As the speed of transportation increases, largely by its own technological momentum, man discovers that he has no choice but to avail himself of that acceleration, either to keep up with others or because he thinks he can thus accomplish more. This will be especially true of the élite, for whom an expansion in leisure time does not seem to be in the cards. Thus as speed expands, time contracts—and the pressures on the élite increase.

By the end of this century the citizens of the more developed countries will live predominantly in cities—hence almost surrounded by man-made environment. Confronting nature could be to them what facing the elements was to our forefathers: meeting the unknown and not necessarily liking it. Enjoying a personal standard of living that (in some countries) may reach almost $10,000 per head, eating artificial food, speedily commuting from one corner of the country to work in another, in continual visual contact with their employer, government, or family, consulting their annual calendars to establish on which day it will rain or shine, our descendants will be shaped almost entirely by what they themselves create and control.

But even short of these far-reaching changes, the transformation that is now taking place is already creating a society increasingly unlike its industrial predecessor.[2] In the industrial society, technical knowledge was applied primarily to one specific end: the acceleration and improvement of production techniques. Social consequences were a later by-product of this paramount concern. In the technetronic society, scientific and technological knowledge, in addition to enhancing productive capabilities, quickly spills over to affect directly almost all aspects of life.

This is particularly evident in the case of the impact of communications and computers. Communications create an extraordinarily interwoven society, in continuous visual, audial, and increasingly close contact among almost all its members—electronically interacting, sharing instantly most intense social experiences, prompting far greater personal involvement, with their consciousnesses shaped in a sporadic manner fundamentally different (as McLuhan has noted) from the literate (or pamphleteering) mode of transmitting information, characteristic of the industrial age. The growing capacity for calculating instantly most complex interactions and the increasing availability of bio-chemical means of human control increase the potential scope of self-conscious direction, and thereby also the pressures to direct, to choose, and to change.

The consequence is a society that differs from the industrial one in a variety of economic, political and social aspects. The following examples may be briefly cited to summarise some of the contrasts:

1. In an industrial society, the mode of production shifts from agriculture to industry, with the use of muscle and animals supplanted by machine-operation. In the technetronic society, industrial employment yields to services, with automation and cybernetics replacing individual operation of machines.

2. Problems of employment and unemployment—not to speak of the earlier stage of the urban socialisation of the post-rural labour force—dominate the relationship between employers, labour, and the market in the industrial society; assuring minimum welfare to the new industrial masses is a source of major concern. In the emerging new society, questions relating to skill-obsolescence, security, vacations, leisure, and profit-sharing dominate the relationship; the matter of psychic well-being of millions of relatively secure but potentially aimless lower-middle class blue collar workers becomes a growing problem.

3. Breaking down traditional barriers to education, thus creating the basic point of departure for social advancement, is a major goal of social reformers in the industrial society. Education, available for limited and specific periods of time, is initially concerned with overcoming illiteracy, and subsequently with technical training, largely based on written, sequential reasoning. In the technetronic society, not only has education become universal but advanced training is available to almost all who have the basic talents. Quantity-training is reinforced by far greater emphasis on quality-selection. The basic problem is to discover the most effective techniques for the rational exploitation of social talent. Latest communication and calculating techniques are applied to that end. The educational process, relying much more on visual and audial devices, becomes extended in time, while the flow of new knowledge necessitates more and more frequent refresher studies.

4. In the industrial society social leadership shifts from the traditional rural-aristocratic to an urban "plutocratic" élite. Newly acquired wealth is its foundation, and intense competition the outlet—as well as the stimulus—for its energy. In the post-industrial technetronic society plutocratic pre-eminence comes under a sustained challenge from the political leadership which itself is increasingly permeated by individuals possessing special skills and intellectual talents. Knowledge becomes a tool of power, and the effective mobilisation of talent an important way for acquiring power.

5. The university in an industrial society—rather in contrast to the medieval times—is an aloof ivory-tower, the repository of irrelevant, even if respected wisdom, and, for only a brief time, the watering fountain for budding members of the established social élite. In the technetronic society, the university becomes an intensely involved *think-tank,* the source of much sustained political planning and social innovation.

6. The turmoil inherent in the shift from the rigidly traditional rural to urban existence engenders an inclination to seek total answers to social dilemmas, thus causing ideologies to thrive in the industrial society.[3] In the technetronic society, increasing ability to reduce social conflicts to quantifiable and measurable dimensions reinforces the trend towards a more pragmatic problem-solving approach to social issues.

7. The activisation of hitherto passive masses makes for intense political conflicts in the industrial society over such matters as disenfranchisement and the right to vote. The issue of political participation is a crucial one. In the technetronic age, the question increasingly is one of ensuring real participation in decisions that seem too complex and too far-removed from the average citizen. Political alienation becomes a problem. Similarly, the issue of political equality of the sexes gives way to a struggle for the sexual equality of women. In the industrial society, woman—the operator of machines—ceases to be physically inferior to the male, a consideration of some importance in rural life, and she begins to demand her political rights. In the emerging society, automation discriminates equally against males and females; intellectual talent is computable; the pill encourages sexual equality.

8. The newly enfranchised masses are coordinated in the industrial society through trade unions and political parties, and integrated by relatively simple and somewhat ideological programmes. Moreover, political attitudes are influenced by appeals to nationalist sentiments, communicated through the massive growth of newspapers, relying, naturally, on native tongues. In the technetronic society, the trend would seem to be towards the aggregation of the individual support of millions of uncoordinated citizens, easily within the reach of magnetic and attractive personalities effectively exploiting the latest communication techniques to manipulate emotions and control reason. Reliance on TV—and hence the tendency to replace language with imagery, with the latter unlimited by national confines (and also including coverage for such matters as hunger in India or war scenes)—tends to create a somewhat more cosmopolitan, though highly impressionistic, involvement in global affairs.

9. Economic power in the industrial society tends to be personalised, either in the shape of great *entrepreneurs* like Henry Ford or bureaucratic industrialisers like Kaganovich in Russia, or Minc in Poland. The tendency towards de-personalisation of economic power is stimulated in the next stage by the appearance of a highly complex interdependence between governmental institutions (including the military), scientific establishments, and industrial organisations. As economic power becomes inseparably linked with political power, it becomes more invisible and the sense of individual futility increases.

10. Relaxation and escapism in the industrial society, in its more intense forms, is a carry-over from the rural drinking bout, in which intimate friends and family would join. Bars and saloons—or fraternities—strive to recreate the atmosphere of intimacy. In the technetronic society social life tends to be so atomised, even though communications (especially TV) make for unprecedented immediacy of social experience, that group intimacy cannot be recreated through the artificial stimulation of externally convivial group behaviour. The new interest in drugs seeks to create intimacy through introspection, allegedly by expanding consciousness.

Eventually, these changes and many others, including the ones that affect much more directly the personality and quality of the human being itself, will make the technetronic society as different from the industrial as the industrial became from the agrarian. . . .

THE TRAUMA OF CONFRONTATION

For the world at large, the appearance of the new technetronic society could have the paradoxical effect of creating more distinct worlds on a planet that is continuously shrinking because of the communications revolution.

While the scientific-technological change will inevitably have some spill-over, not only will the gap between the developed and the underdeveloped worlds probably become wider—especially in the more measurable terms of economic indices—but a *new one* may be developing *within* the industrialised and urban world.

The fact is that America, having left the industrial phase, is today entering a distinct historical era: and one different from that of Western Europe and Japan. This is prompting subtle and still indefinable changes in the American psyche, providing the psycho-cultural bases for the more evident political disagreements between the two sides of the Atlantic. To be sure, there are pockets of innovation or retardation on both sides. Sweden shares with America the problems of leisure, psychic well-being, purposelessness; while Mississippi is experiencing the confrontation with the industrial age in a way not unlike some parts of South-Western Europe. But I believe the broad generalisation still holds true: Europe and America are no longer in the same historical era.

What makes America unique in our time is that it is the first society to experience the future. The confrontation with the new—which will soon include much of what I have outlined—is part of the daily American experience. For better or for worse, the rest of the world learns what is in store for it by observing what happens in the U.S.A.: in the latest scientific discoveries in space, in medicine, or the electric toothbrush in the bathroom; in pop art or LSD, air conditioning or air pollution, old-age problems or juvenile delinquency. The evidence is more elusive in such matters as music, style, values, social mores; but there, too the term "Americanisation" obviously defines the source. Today, America is *the* creative society; the others, consciously and unconsciously, are emulative.

American scientific leadership is particularly strong in the so-called "frontier" industries, involving the most advanced fields of science. It has been estimated that approximately 80% of all scientific and technical discoveries made during the last few decades originated in the United States. About 75% of the world's computers operate in the United States; the American lead in lasers is even more marked; examples of American scientific lead are abundant.

There is reason to assume that this leadership will continue. America has four times as many scientists and research workers as the countries of the European Economic Community combined; three-and-a-half times as many as the Soviet Union. The brain-drain is almost entirely one-way. The United States is also spending more on research: seven times as much as the E.E.C. countries, three-and-a-half times as much as the Soviet Union. Given the fact that scientific development is a dynamic process, it is likely that the gap will widen.[4]

On the social level, American innovation is most strikingly seen in the manner in which the new meritocratic élite is taking over American life, utilising the universities, exploiting the latest techniques of communications, harnessing as rapidly as possible the most recent technological devices. Technetronics dominate American life, but so far nobody else's. This is bound to have social and political—and therefore also psychological—consequences, stimulating a psycho-cultural gap in the developed world.

At the same time, the backward regions of the world are becoming more, rather than less, poor in relation to the developed world. It can be roughly estimated that the per capita income of the underdeveloped world is approximately ten times lower than of America and Europe (and twenty-five times of America itself). By the end of the century, the ratio may be about fifteen-to-one (or possibly thirty-to-one in the case of the U.S.), with the backward nations *at best* approaching the present standards of the very poor European nations but in many cases (*e.g.*, India) probably not even attaining that modest level.

The social élites of these regions, however, will quite naturally tend to assimilate and emulate, as much as their means and power permit, the life-styles of the most advanced world, with which they are, and increasingly will be, in close vicarious contact through global television, movies, travel, education, and international magazines. The international gap will thus have a domestic reflection, with the masses, given the availability even in most backward regions of transistorised radios (and soon television), becoming more and more intensely aware of their deprivation.

It is difficult to conceive how in that context democratic institutions (derived largely from Western experience—but typical only of the more stable and wealthy Western nations) will endure in a country like India, or develop elsewhere. The foreseeable future is more likely to see a turn towards personal dictatorships and some unifying doctrines, in the hope that the combination of the two may preserve the minimum stability necessary for social-economic development. The problem, however, is that whereas in the past ideologies of change gravitated from the developed world to the less, in a way stimulating imitation of the developed world (as was the case with Communism), today the differences between the two worlds are so pronounced that it is difficult to conceive a new ideological wave originating from the developed world, where the tradition of utopian thinking is generally declining.

With the widening gap dooming any hope of imitation, the more likely development is an ideology of rejection of the developed world. Racial hatred could provide the necessary emotional force, exploited by xenophobic and romantic leaders. The writings of Frantz Fanon—violent and racist—are a good example. Such ideologies of rejection, combining racialism with nationalism, would further reduce the chances of meaningful regional cooperation, so essential if technology and science are to be effectively applied. They would certainly widen the existing psychological and emotional gaps. Indeed, one might ask at that point: who is the truer repository of that indefinable quality we call human? The technologically dominant and conditioned technetron, increasingly trained to adjust to leisure, or the more "natural" and backward agrarian, more and more dominated by racial passions and continuously exhorted to work harder, even as his goal of the good life becomes more elusive?

The result could be a modern version on a global scale of the old rural-urban dichotomy. In the past, the strains produced by the shift from an essentially agricultural economy to a more urban one contributed much of the impetus for revolutionary violence.[5] Applied on a global scale, this division could give substance to Lin Piao's bold thesis that:

> Taking the entire globe, if North America and Western Europe can be called "the cities of the world," then Asia, Africa, and Latin America constitute "the rural areas of the world." . . . In a sense, the contemporary world revolution also presents a picture of the encirclement of cities by the rural areas.

In any case, even without envisaging such a dichotomic confrontation, it is fair to say that the underdeveloped regions will be facing increasingly grave problems of political stability and social survival. Indeed (to use a capsule formula), in the developed world, the nature of man as man is threatened; in the underdeveloped, society is. The interaction of the two could produce chaos.

To be sure, the most advanced states will possess ever more deadly means of destruction, possibly even capable of nullifying the consequences of the nuclear proliferation that appears increasingly inevitable. Chemical and biological weapons, death rays, neutron bombs, nerve gases, and a host of other devices, possessed in all their sophisticated variety (as seems likely) only by the two super-states, may impose on the world a measure of stability. Nonetheless, it seems unlikely, given the rivalry between the two principal powers, that a fool-proof system against international violence can be established. Some local wars between the weaker, nationalistically more aroused, poorer nations may occasionally erupt—resulting perhaps even in the total nuclear extinction of one or several smaller nations?—before greater international control is imposed in the wake of the universal moral shock thereby generated.

The underlying problem, however, will be to find a way of avoiding somehow the widening of the cultural and psycho-social gap inherent in the growing differentiation of the world. Even with gradual differentiation throughout human history, it was not until the industrial revolution that sharp differences between societies began to appear. Today, some nations still live in conditions not unlike pre-Christian times; many no different than in the medieval age. Yet soon a few will live in ways so new that it is now difficult to imagine their social and individual ramifications. If the developed world takes a leap—as seems inescapably the case—into a reality that is even more different from ours today than ours is from an Indian village, the gap and its accompanying strains will not narrow.

On the contrary, the instantaneous electronic intermeshing of mankind will make for an intense confrontation, straining social and international peace. In the past, differences were "livable" because of time and distance that separated them. Today, these differences are actually widening while technetronics are eliminating the two insulants of time and distance. The resulting trauma could create almost entirely different perspectives on life, with insecurity, envy, and hostility becoming the dominant emotions for increasingly large numbers of people. A three-way split into rural-backward, urban-industrial, and technetronic ways of life can only further divide man, intensify the existing difficulties to global understanding, and give added vitality to latent or existing conflicts.

The pace of American development both widens the split within mankind and contains the seeds for a constructive response. However, neither military power nor material wealth, both of which America possesses in abundance, can be used directly in responding to the onrushing division in man's thinking, norms, and character. Power, at best, can assure only a relatively stable external environment: the tempering or containing of the potential global civil war; wealth can grease points of socio-economic friction, thereby facilitating development. But as man—especially in the most advanced societies—moves increasingly into the phase of controlling and even creating his environment, increasing attention will have to be given to giving man meaningful content—to improving the quality of life for man *as man*.

> Man has never really tried to use science in the realm of his value systems. Ethical thinking is hard to change, but history demonstrates that it does change. . . . Man does, in limited ways, direct his very important and much more rapid psycho-social education. The evolution of such things as automobiles, airplanes, weapons, legal institutions, corporations, universities, and democratic governments are examples of progressive evolution in the course of time. We have, however, never really tried deliberately to create a better society for man *qua* man. . . .[6]

The urgent need to do just that may compel America to redefine its global posture. During the remainder of this century, given the perspective on the future I have outlined here, America is likely to become less concerned with "fighting communism" or creating "a world safe for diversity" than with helping to develop a common response with the rest of mankind to the implications of a truly new era. This will mean making the massive diffusion of scientific-technological knowledge a principal focus of American involvement in world affairs.

To some extent, the U.S. performs that role already—simply by being what it is. The impact of its reality and its global involvement prompts emulation. The emergence of vast international corporations, mostly originating in the United States, makes for easier transfer of skills, management techniques, marketing procedures, and scientific-technological innovations. The appearance of these corporations in the European market has done much to stimulate Europeans to consider more urgently the need to integrate their resources and to accelerate the pace of their own research and development.

Similarly, returning graduates from American universities have prompted an organisational and intellectual revolution in the academic life of their countries. Changes in the academic life of Britain, Germany, Japan, more recently France, and (to even a greater extent) in the less developed countries, can be traced to the influence of U.S. educational institutions. Indeed, the leading technological institute in Turkey conducts its lectures in "American" and is deliberately imitating, not only in approach but in student-professor relationships, U.S. patterns. Given developments in modern communications, is it not only a matter of time before students at Columbia University and, say, the University of Teheran will be watching, *simultaneously,* the same lecturer?

The appearance of a universal intellectual élite, one that shares certain common values and aspirations, will somewhat compensate for the widening differentiation among men and societies. But it will not resolve the problem posed by that differentiation. In many backward nations tension between what is and what can be will be intensified. Moreover, as Kenneth Boulding observed:

> The network of electronic communication is inevitably producing a world super-culture, and the

relations between this super-culture and the more traditional national and regional cultures of the past remains the great question mark of the next fifty years.[7]

That "super-culture," strongly influenced by American life, with its own universal electronic-computer language, will find it difficult to relate itself to "the more traditional and regional cultures," especially if the basic gap continues to widen.

To cope with that gap, a gradual change in diplomatic style and emphasis may have to follow the redefined emphasis of America's involvement in world affairs. Professional diplomacy will have to yield to intellectual leadership. With government negotiating directly—or quickly dispatching the negotiators—there will be less need for ambassadors who are resident diplomats and more for ambassadors who are capable of serving as creative interpreters of the new age, willing to engage in a meaningful dialogue with the host intellectual community and concerned with promoting the widest possible dissemination of available knowledge. Theirs will be the task to stimulate and to develop scientific-technological programmes of co-operation.

International co-operation will be necessary in almost every facet of life: to reform and to develop more modern educational systems, to promote new sources of food supply, to accelerate economic development, to stimulate technological growth, to control climate, to disseminate new medical knowledge. However, because the new élites have a vested interest in their new nation-states and because of the growing xenophobia among the masses in the third world, the nation-state will remain for a long time the primary focus of loyalty, especially for newly liberated and economically backward peoples. To predict loudly its death, and to act often as if it were dead, could prompt (as it did partially in Europe) an adverse reaction from those whom one would wish to influence. Hence, regionalism will have to be promoted with due deference to the symbolic meaning of national sovereignty—and preferably also by encouraging those concerned themselves to advocate regional approaches.

Even more important will be the stimulation, for the first time in history on a global scale, of the much needed dialogue on what it is about man's life that we wish to safeguard or to promote, and on the relevance of existing moral systems to an age that cannot be fitted into the narrow confines of fading doctrines. The search for new directions—going beyond the tangibles of economic development—could be an appropriate subject for a special world congress, devoted to the technetronic and philosophical problems of the coming age. To these issues no one society, however advanced, is in a position to provide an answer.

NOTES

[1]Perhaps the most useful single source is to be found in the Summer 1967 issue of *Daedalus*, devoted entirely to *"Toward the Year 2000: Work in Progress."* The introduction by Professor Daniel Bell, chairman of the American Academy's Commission on the Year 2000 (of which the present writer is also a member) summarises some of the principal literature on the subject.

[2]See Daniel Bell's pioneering "Notes on the Post-Industrial Society," *The Public Interest*, Nos. 6 and 7, 1967.

[3]The American exception to this rule was due to the absence of the feudal tradition, a point well developed by Louis Hartz in his work *The Liberal Tradition in America* (1955).

[4]In the Soviet case, rigid compartmentalisation between secret military research and industrial research has had a particularly sterile effect of inhibiting spill-over from weapons research into industrial application.

[5]See Barrington Moore's documentation of this in his pioneering study *Social Origins of Dictatorship and Democracy* (1967).

[6]Hudson Hoagland, "Biology, Brains, and Insight," *Columbia University Forum*, Summer 1967.

[7]Kenneth Boulding, "Expecting the Unexpected," *Prospective Changes in Society by 1980* (1960).

RELIGIOUS

From "Technical Progress and Sin"

GABRIEL MARCEL

■ Gabriel Marcel *was born in 1889 in Paris. He was raised in a home dominated by his father's agnosticism and his aunt's liberal protestantism. Nevertheless, Marcel was highly interested in the religious dimension of human experience. In 1929 he converted to Catholicism and became subsequently an intellectual leader in French Catholic circles. During World War I he joined the Red Cross, and his experiences during that period left permanent marks on the direction of his thought. For he realized then the inability of abstract philosophy to cope with the tragic character of human existence. Among his chief works are* The Mystery of Being *(1950) and* Man Against Mass Society *(1951).*

Gabriel Marcel is not an anti-technologist as one might infer from the title of the selection that appears here. On the contrary, "technique is rather something good or the expression of something good, since it amounts to nothing more than a specific instance of our general application of our gift of reason to reality." Nevertheless, Marcel is only too well aware of the relation between technological progress and sin. It is the basis of this relationship that he explores in this selection. According to him, things start going wrong when feelings of power and pride, which an inventor justifiably experiences, "lose their just pretext and their authenticity, in the case of the man who benefits from an invention without having made any contribution towards discovering or perfecting it." This leads first to a kind of "idolatry" of technical products, which weakens the sense of the sacred, and then to "autolatry," that is, self-worship.

Marcel evaluates the pros and cons of communicational advances made possible by technological progress. (Compare these views with those given in Part Two under the heading "Media-oriented".) He also discusses the vice of "envy," which for him is another outgrowth of technological progress. All this leads him to conclude that nothing will save the technological man except "an act of faith."

In the opening paragraph of this selection, Marcel is examining the universal human emotion of indignation that is prompted by wartime atrocities.

This almost universal emotion in the face of horror—an emotion, it may be admitted, that has so far had no appreciable effect in preventing horrors from occurring—is the coming to the surface of a deep sense of piety towards life; and that at an epoch where thought at the more conscious and rationalizing level is being led more and more into denying that life has any "sacred" character; and it is in connection with this spontaneous piety, but as outraging it (and more often than not quite independently of any positive religious attachment, of any link with historical revelation), that these acts, which we have been the witnesses or victims of, seem to us to bear the undeniable mark of sin.

Whatever attempts there may have been in the past to justify war, or at least to recognize a certain spiritual value in war, we ought to proclaim as loudly as possible that war with the face it wears to-day is sin itself. But at the same time we cannot fail to recognize that war is becoming more and more an affair of technicians: it presents to-day the double aspect of destroying whole populations without distinction of age or sex, and of tending more and more to be conducted by a small number of individuals, powerfully equipped, who direct operations from the safe depths of their laboratories. The fate of war and that of technical advancement, in our time, whether or not this conjunction is a merely accidental one, seem to be inextricably linked; and it can be asserted even that, at least in our present phase of history, everything that gives a new impetus to technical research at the same time renders war more radically destructive, and bends it more and more inexorably to what, at the breaking point, would be quite simply the suicide of the human race.

In a strange way, this connection between technical progress and sin becomes clearer if we remember on the one hand that to-day only the State is rich enough to finance the gigantic laboratories in which the new physics is being applied and developed; and on the other hand that, in a world given over like our own to rival imperialisms, the State itself, that "Great Leviathan", to use the phrase of Hobbes, is inevitably led to demand that such researches should be directed towards everything that can increase the power of the State in its coming conflict with its rivals. It is in relation to these facts that we are forced to assert that the growing state-

☐ From *Man Against Mass Society*, trans. G. S. Fraser (South Bend, Ind.: Regnery/Gateway, Inc., 1952), pp. 60-66. Reprinted by permission of the publisher.

control of scientific and technical research is one of the worst calamities of our time.

When we reflect on it, however, this tragic situation of ours is very far from appearing a *natural* situation. We cannot say that the realm of the technical is evil in itself or that progress at the technical level ought, as such, to be condemned. Even to pretend that this were so would be to relapse into childishness. We can immediately see, even though it is perhaps impossible to discover the logical basis for this opinion, that it would be absurd to hope to solve the present crisis by closing down the factories and the laboratories for good and all. There is every reason to suppose, on the contrary, that such a step would be the starting point of an almost unimaginable regression for the human race.

The truth is that if we want to state the problem of the relationship between technical progress and sin in acceptable terms we must go back to first principles. In the last analysis, what *is* a technique? It is a group of procedures, methodically elaborated, and consequently capable of being taught and reproduced, and when these procedures are put into operation they assure the achievement of some definite concrete purpose. As I have just been saying, the realm of the technical, as thus defined, is not to be considered as evil in itself; if we think of it in itself, as I have already said, a technique is rather something good or the expression of something good, since it amounts to nothing more than a specific instance of our general application of our gift of reason to reality. To condemn technical progress is, therefore, to utter words empty of meaning. But from the point of view of truth, what we must do is not to cling to our abstract definition but rather to ask ourselves about the concrete relationship that tends to grow up between technical processes on the one hand and human beings on the other; and here things become more complicated.

In so far as a technique is something that we can acquire, it may be compared to a possession—like habit, which is at bottom itself already a technique. And we can at once see that if a man can become the slave of his habits, it is equally probable that he can become the prisoner of his techniques. But we have to go deeper. The truth is that a technique, for the man whose task it is *to invent it,* does not present itself simply as a means; for a time at least, it becomes an end in itself, since it has to be discovered, to be brought into being; and it is easy to understand how a mind absorbed in this task of discovery can be drawn away from any thought of the real purpose to which, in principle, this technique ought to be subordinate. To take a simple example, it is clear enough that a technician to whom, for one reason or another, travelling is impossible or forbidden, might nevertheless devote himself to the improvement of design in motor-cars. I should be tempted to say that all technical progress implies a certain moral and intellectual outlay (of attention, ingenuity, perseverance, and so on) which betrays itself by a feeling of power or of pride; in which fact, of course, there is nothing that is not usual and allowable. Such feelings are the natural accompaniment of inventive activity. But they become unnatural, as we have already seen, they lose their just pretext and their authenticity, in the case of the man who benefits from an invention without having made any contribution towards discovering and perfecting it. We can understand this if we think of the state of mind of certain motorists who acquire a kind of passion for their car, spend their time swapping one car for another, and thus become less and less capable of considering the car as what it is, a means for getting about. The lack of curiosity of the passionate motorist is a fact of common experience. But this remark has a much more general application, and is true for instance also of radio enthusiasts. What we are noticing here is the passage from the realm of the technical, properly so called, to that of a kind of idolatry of which technical products become the object or at least the occasion. And if we follow out this line of reflection, we can see that even this kind of idolatry can degenerate into something worse; it can become *autolatry,* worship of oneself, and often does so in those circles where people can get excited only about records, especially speed records. Certainly, there is a great deal here that we ought to go into more deeply; we could ask ourselves how it is that speed has come to be regarded as an end rather than a means, how it has come to be sought out for its own sake—and we ought to contrast such a state of mind with that of the traveller of the old days, and particularly of the pilgrim, for whom the very slowness of progress was linked to a feeling of veneration. The transformation that has taken place in these matters seems to have even metaphysical significance. In a very general way, we might say that the exaltation of speed records goes hand in hand with a weakening, an attenuation, of the sense of the sacred.

But let us consider another much more general and much more important aspect of the same phenomenon. One might say that the notion of technical progress, at least in our own day, implies above all the notion of progress in communications. The perfecting of means of transport has been to all appearances the condition (while at the same time, of course, one of the effects) of the industrialization which has been proceeding with an accelerating rhythm during the past century. But what we must concentrate our powers of reflection on is just this very notion of communication, taken in a quite external sense. That the world should cease to be divided into many little compartments, that the country folk, in particular, should cease to live, in their own little closed regions, an entirely local life, a life with no relation to that of other neighbouring groups, all that seems to me an infinitely happy transformation, and one which by itself would serve to justify the belief in progress. But we must be careful here. Naturally, it is true to say that this general development of communications *can* or *could*—ought to be able to—produce excellent results: that, for instance, where some new good thing has been discovered, the development of communications guarantees a widespread use of this good thing that would not have been imaginable a century ago. Let us think, for instance, of medicines (serums or penicillin) taken by aeroplane to sick people who, without such outside help, would undoubtedly have died. But this good possibility is only one possibility among many; we ought to ask ourselves whether there are not also evil possibilities whose very principle is to be found just in this perfecting of communication, in a quite external sense, of which we have been talking.

Do we not find, both on the world scale and at the level of national existence, that the development of communications entails a growing uniformity imposed upon our customs and habits? In other words, this perfecting of communications is achieved everywhere at the expense of an individuality which is tending to-day more and more to vanish away: and we are thinking here of beliefs, customs, traditions, as well as of local costumes, local craftsmanship, and so on. If we were taking a quite superficial view of human psychology and history, we might be tempted to say that this elimination of the picturesque is the unavoidable price that we pay for a greater good; for this reduction of habits to a general uniformity might, of course, be the beginning of a genuine unification of mankind. But our contemporary experience allows us to say quite definitely that there is nothing in this argument and that the imposing of uniformity, far from setting men on the path towards a kind of concrete assimilation of the universal, seems on the contrary to develop in them narrowly particular loyalties of a more and more aggressive sort, and to set competing groups against each other.

This might seem quite paradoxical, but reflection clears up the difficulty. Is it not obvious that technical and industrial progress have combined to create for men a kind of lowest common denominator of well-being which becomes an inspirer of covetousness and everywhere gives rise to envy? At the bottom, this lowest common denominator is merely wealth, one might say it is merely cash; but in saying that one should add that, by a very disturbing dialectical process, just as money becomes the lowest common denominator of well-being, so money itself tends to lose all substantial or even apparent reality, to become, in short, a fiction. After all, envy is only possible on the basis of what might be called a common drawing-account; it is less conceivable as existing between individuals and between peoples who have each their own traditions and their own separate genius, of which they are rightly proud. To be sure, this originality of each local and national tradition in respect to every other one has been very far, throughout history, from excluding quarrels and wars; up to a certain point, it has even encouraged them. But these quarrels, these wars, however bloody they may have been, did retain a human character; they did not exclude mutual respect, they made real reconciliations possible. There is nothing in them which at all resembles these attempts at collective extermination of which I spoke at the beginning of this chapter. But, besides all this, it would be of the greatest interest to discover by what odd mechanism ideological conflicts, to-day, conflicts sometimes quite without deep significance, have been able to superimpose themselves on elementary—and alimentary—antagonisms whose sole basis can finally be seen as envy.

It can, of course, always be claimed that this common drawing fund for envy, this lowest common denominator, however regrettable its immediate consequences may be, was none the less necessary, and that in the long run the current growth of uniformity will allow men to form a really organic and harmonious single body. It is difficult to make any judgment on such prophecies. But what must be recognized, it seems to me, speaking in all good faith, is that, if we consider things in a purely rational fashion, we can find no serious reason for expecting an *automatically* favourable outcome to the crisis which mankind is going through today. One cannot help observing that those ideological conflicts, which I have just been alluding to, tend to-day, so to say, to *make themselves at home* even in small country villages where, in the past, a friendly good-will prevailed and where to-day we can see the reign of mutual fear and suspicion. It is, of course, still possible to say that this is a purely transitional state of affairs; but the truth is that nobody sees how the state of affairs can be bettered in a way that would suit the aspirations of those who love peace and who also love what Victor Hugo called "concord among citizens". In reality, unless we have recourse to an act of faith, perfectly legitimate in itself and from the religious point of view even requisite, but quite foreign to the spirit of the man of mere technique, we should have to say that the malady from which mankind to-day appears to be suffering is perhaps mortal, and that there is nothing, at the purely human level, which insures our race against that risk of collective suicide . . .

RELIGIOUS

From "Man and Machine"

NICHOLAS BERDYAEV

■ Nicholas Berdyaev *(1874-1948) was born near Kiev in Russia. He was a philosopher and a religious thinker who bridged the gap between religious thought in Russia and the West. He was a leading exponent of Christian existentialism. As a youth he was associated with Marxism. But because his views developed along different lines, he was exiled after the revolution, and he went to Paris in 1924. In his philosophy, his major concern has always been man. He strongly advocated a society which gives each individual the ability to be both free and creative. Among his works are* The New Middle Ages *(1924) and* Slavery and Freedom *(1939).*

In the essay "Man and Machine" *(1933) Berdyaev wages a bitter attack on technique: "The world is being dehumanized as well as dechristianized by the monstrous power of technique." This power is seen as "bound up" not only with the machine, but with capitalism and communism, both of which are rejected by the author. According to Berdyaev, the problem with modern technology is that it deals "terrible blows to man's emotional side, to human feelings." Thus it is the heart and not the spirit which is primarily endangered today. But to combat this situation man must intensify his own spirituality. The human spirit "must not be isolated and dependent only upon itself—it must be united to God." This would strengthen it, and consequently enable it to limit the powers of technique, utilizing technique only for the good of humanity. In this Berdyaev seems to be in agreement with Marcel (see preceding selection).*

Wherein consists the menace of the machine to man, the danger now so clearly apparent? I doubt if it threatens spirit and the spiritual life, but the machine and technique deal terrible blows to man's emotional side, to human feeling, which is on the wane in contemporary civilization. Whereas the old culture threatened man's body, which is neglected and often debilitated, mechanical civilization endangers the heart, which can scarcely bear the contact of cold metal and is unable to live in metallic surroundings. The process of the destruction of the heart as the center of emotional life is characteristic of our times. In the works of such outstanding French writers as Proust and Gide the heart as an integral organ of man's emotional life is inexistent, everything has been decomposed into the intellectual element and sensual feelings. Keyserling is right when he speaks of the destruction of the emotional order in modern civilization and longs for its restoration.[1] Technique strikes fiercely at humanism, the humanist conception of the world, the humanist ideal of man and culture. It seems surprising at first to be told that technique is not so dangerous to

☐ From *"The Bourgeois Mind" and Other Essays*, trans. Countess Bennigsen, revised by Donald Attwater (New York: Books For Libraries Press, Inc., 1966), pp. 52-64. Reprinted by Books For Libraries Press. Distributed by Arno Press, Inc.

spirit, yet we may in truth say that ours is the age of technique and spirit, not an age of the heart. The religious significance of contemporary technique consists precisely in the fact that it makes everything a spiritual problem and may lead to the spiritualization of life, for it demands an intensification of spirituality.

Technique has long ceased to be neutral, to be indifferent to spirit and its problems, and, after all, can anything really be neutral? Some things may appear so at a casual glance but, while technique is fatal to the heart, it produces a powerful reaction of the spirit. Through technique man becomes a universal creator, for his former arms seem like childish toys in comparison with the weapons it places in his hands now. This is especially apparent in the field of military technique. The destructive power of the weapons of old was very limited and localized; with cannon, muskets, and sabers neither great human masses nor large towns could be destroyed nor could the very existence of civilization be threatened. All this is now feasible. Peaceful scientists will be able to promote cataclysms not only on a historical but on a cosmic scale; a small group possessing the secrets of technical inventions will be able to tyrannize over the whole of mankind; this is quite plausible, and was foreseen by Renan. When man is given power whereby he may rule the world and wipe out a considerable part of its inhabitants and their culture, then everything depends upon man's spiritual and moral standards, on the question: In whose name will he use this power—of what spirit is he?

Thus we see that this problem of technique inevitably becomes a spiritual and ultimately a religious one, and the future of the human race is in the balance. The miracles of technique are always double, and demand an intensification of the spirit infinitely greater than in former cultural ages. Man's spirituality can no more be organically vegetative; we are faced by the demands of a new herosim, internal and external. Our herosim, bound up with warfare in old times, is now no more; it scarcely existed in the last war; technique demands a new kind of heroism, and we are constantly hearing and reading of its manifestations—scientists leaving their laboratories and studies and flying into the stratosphere or diving to the bottom of the ocean. Human heroism is now connected with cosmic spheres. But, primarily, a strong spirit is needed in order to safeguard man from enslavement and destruction through technique, and in a certain sense we may say it is a question of life or death. We are sometimes haunted by a horrible nightmare: a time may come when machinery will have attained so great a perfection that man would have governed the world through it had he not altogether disappeared from the earth; machines will be working independently, without a hitch and with a maximum of efficiency and results; the last men will become like machines, then they will vanish, partly because they will be unnecessary and also because they will be unable to live and breathe any longer in the mechanized atmosphere; factories will be turning out goods at great speed and airplanes will be flying all over the earth; the wireless will be carrying the sound of music and singing and the speech of the men that once lived; nature will be conquered by technique and this new actuality will be a part of cosmic life. But man himself will be no more, organic life will be no more—a terrible utopia! It rests with man's spirit to escape this fate. The exclusive power of technical organization and machine production is tending toward its goal—inexistence within technical perfection. But we cannot admit an autonomous technique with full freedom of action: it *has* to be subordinated to spirit and the spiritual values of life—as everything else has to be. Only upon one condition can the human spirit cope with this tremendous problem: it must not be isolated and dependent only upon itself—it must be united to God. Then only can man preserve the image and likeness of his maker and be himself preserved. There is the divergence between Christian and technical eschatology.

The power of technique in human life results in a very great change in the prevalent type of religiousness, and we must admit that this is all for the good. In a mechanical age the hereditary, customary, formal, socially established sort of religion is weakened; the religiously-minded man feels less tied to traditional forms, his life demands a spiritually intensified Christianity, free from social influences. Religious life tends to become more personal, it is more painfully attained, and this is not individualism, for the universality and mystical unity of religious consciousness are not sociological.

Yet in another respect the domination of technique may be fatal for religious and spiritual life. Technique conquers time and radically alters our relations to it: man becomes capable of mastering time, but technical actuality subordinates him and his inward life to time's accelerating movement. In the crazy speed of contemporary civilization not one single instant is an end in itself and not a single moment can be fixed as being outside time. There is no exit into an instant *(Augenblick)* in the sense Kirkegaard speaks of it: every moment must speedily be replaced by the next, all remaining in the stream of time and therefore ephemeral. Within each moment there seems to be nothing but motion toward the next one: in itself it is void. Such a conquest of time through speed becomes an enslavement to the current of time, which means that in this relation technical activity is destructive of eternity. Man has no time for it, since what is demanded of him is the quickest passage to the succeeding instant. This does not mean that we must see in the past the eternal which is being destroyed by the future: the past does not belong to eternity any more than does the future—both are in time. In the past, as in the future and at all times, an exit into eternity, the self-sufficient complete instant, is always possible. Time obeys the speed machine, but is not mastered and conquered by it, and man is faced by the question: Will he remain capable of experiencing moments of pure contemplation, of eternity, truth, beauty, God? Unquestionably, man has an active vocation in the world and there is truth in action, but he is also a being capable of contemplation in which there is an element determining his ego. The very act of man's contemplation, his relation to God, contains a creative deed. The formulation of this problem more than ever convinces us that all the ills of modern civilization are due to the discrepancy between the organization of man's soul inherited from other ages and the new technical, mechanical actuality from which he cannot escape. The human soul is unable to stand the speed which contemporary civilization demands and which tends to transform man himself into a machine. It is a painful process. Contemporary man endeavors to strengthen his body through sports, thus fighting anthropological regression. We cannot deny the positive value of sport whereby man reverts to the old Hellenic view of the body, yet sport may become a means of destruction; it will create distortion instead of harmony if not subordinated to his integral idea. By its nature technical civilization is impersonal; it demands man's activity, while denying him the right to a personality, and therefore he experiences an immense difficulty in surviving in such a civilization. In every way *person* is in opposition to *machine*, for person is primarily unity in multiplicity and integrity, it is its own end and refuses to be transformed into a part, a means, an instrument. On the other hand, technical civilization and mechanized society demand that man should be that and nothing else: they strive to destroy his unity and integrity or, in other words, deny him his personality. A fight to the death between this civilization and society and the human person is inevitable; it will be man versus machine. Technique is pitiless to all that lives and exists, and therefore concern for the living and existing has to restrict the power of technique over life.

The machine-mind triumphing in a capitalist civilization begins by perverting the hierarchy of values, and the reinstatement of that hierarchy marks the limitation of the power of the machine. This cannot be done by a reversion to the old structure of the soul and the former natural and organic actuality.[2] The character of modern technical civilization and its influence upon man is inacceptable not only to Christian consciousness but also to man's natural dignity. We are faced by the task of saving the very image of man. He has been called to continue creation and his work represents the eighth day: he was called to be king and master of the earth, yet the work he is doing and to which he was called enslaves him and defaces his image. So a new man appears, with a new structure of the soul, a new image. The man of former days believed himself to be the everlasting man; he was mistaken, for though he possessed an eternal principle he was not eternal: the past is not eternity. A new man is due to appear in the world and the problem consists in the question, not of his relation to the old man, but of his relation to everlasting man, to the eternal in him—and this eternal principle is the divine image and likeness whereby he becomes a person. This is not to be understood statically, for the divine image in man, as in a natural being, is manifested and confirmed dynamically—in this consists the endless struggle against the old man in the name of the new man. But the machine age strives to replace the image and likeness of God by the image and likeness of the machine, and this does not mean the creation of a new man but the destruction and disappearance of man, his substitution by another being with another, nonhuman, existence. Man created the machine, and this may give him a grand feeling of his own dignity and power, but this pride imperceptibly and gradually leads to his humiliation. All through history man has been changing, he has always been old and new, but throughout the ages he was in contact with eternity and remained man. The new man will finally break away from eternity, will definitely fasten on to the new world he has to possess and conquer, and will cease to be human, though at first he will fail to realize the change. We are witnessing man's dehumanization, and the question is: Is he to be or not to be, not the ancient man who has to be outlived, but just simply man? From the very dawn of human consciousness, as manifested in the Bible and in ancient Greece, this problem has never been posited with such depth and acuteness. European humanism believed in the eternal foundations of human nature, and inherited this belief from the Greco-Roman world. Christianity believes man to be God's creation, bearing his image and likeness and redeemed by his divine son. Both these faiths strengthen European man, who believes himself to be universal, but now they have been shaken; the world is being dehumanized as well as dechristianized by the monstrous power of technique.

This power, like that of the machine, is bound up with capitalism; it originated in the very womb of the capitalist order, and the machine was the strongest weapon for its development. Communism has taken over these things wholesale from capitalist civilization and made a veritable religion of the machine: it worships it as a totem. Undoubtedly, since technique has created capitalism it may also help to conquer it and to create a less unjust social order: it may become a mighty arm in the solution of the social problem. But all will depend on the question, which spirit predominates, of which spirit man will be. Materialistic communism subordinates the problem of man, as a being composed of soul and body, to the problem of society; it is not for man to organize society, but for society to organize man. The truth is the other way around—primacy belongs to man; it is he who has to organize society and the world, and its organization is dependent upon his spirit. Here man is taken not as an individual being but as a social being with a social vocation to fulfill, since only then has he an active and creative vocation. In our days it is usual to hear people, victims of the machine, accuse it, making it responsible for their crippling; this only humiliates man and does not correspond to his dignity. It is not machinery, which is merely man's creation and consequently irresponsible, that is to be blamed, and it is unworthy to transfer responsibility from man to a machine. Man alone is to blame for the awful power that threatens him; it is not the machine which has despiritualized him—he did it himself. The problem has to be transferred from the outward to the inward. A limitation of the power of technique and machinery over human life is a mission of the spirit; therefore, man has to intensify his own spirituality. The machine can become, in human hands, a great asset for the conquest of the elements of nature on the sole condition that man himself becomes a free spirit. A wholesale process of dehumanization is going on and mechanicism is only the projection of this dehumanization. We can see this process in the dehumanizing of physical science. It studies invisible light rays and inaudible sounds, and thereby leads man beyond the limits of his familiar world of light and sound; Einstein carries him beyond the world of space. These discoveries have a positive value and witness to the strength of human consciousness. Dehumanization is a spiritual state, the relation of the spirit to man and to the world.

Christianity liberated man from the bonds of the cosmic infinity that enslaved the ancient world, from the power of natural spirits and demons; it set him upright, strengthened him, made him dependent upon God and not upon nature. But in the science which became accessible when man emancipated himself from nature, on the heights of civilization and technique, he discovers the mysteries of cosmic life formerly hidden from him and the action of energies formerly dormant in the depths of nature. This manifests his power, but it also places him in a precarious position in relation to the universe. His aptitude for organization disorganizes himself internally, and a new problem faces Christianity. Its answer to it presupposes a modification of Christian consciousness in the understanding of man's vocation in the world. The center is in the Christian view of man as such, for we can no longer be satisfied by the patristic, scholastic, or humanistic anthropologies. From the point of view of cognition, a philosophical anthropology becomes a central problem: man and machine, man and organism, man and cosmos, are what it has to deal with. In working out his historical destiny, man traverses many different stages, and invariably his fate is a tragic one. At first he was the slave of nature and valiantly fought for his own preservation, independence, and liberty. He created culture, states, national units, classes, only to become enslaved by his own creations. Now he is entering upon a new period and aims at conquering the irrational social forces; he establishes an organized society and a developed technique, but again becomes enslaved, this time by the machine into which society and himself are becoming transformed. In new and ever newer forms this problem of man's liberation, of his conquest of nature and society, is being restated, and it can only be solved by a consciousness which will place him above them, the human soul above all natural and social forces. Everything that liberates man has to be accepted, and that which enslaves him rejected. This truth about man, his dignity and his calling, is embodied in Christianity, though maybe it has been insufficiently manifested in history and often even perverted. The way of man's final liberation and realization of his vocation is the way to the kingdom of God, which is not only that of Heaven but also the realm of the transfigured earth, the transfigured cosmos.

NOTES

1. See his *Meditations Sud-Americaines*. [This is the French translation of Hermann Alexander Keyserling, *Sudamerikanische Meditationen* (Stuttgart: Deutsche Verlags-Anstalt, 1932). English translation by the author and Theresa Duerr, *South American Meditations on Hell and Heaven in the Soul of Man* (New York: Harper, 1932).]
2. The important book of Gina Lombroso, *La rançon du machinisme*, displays too great a faith in the possibility of a return to a pre-mechanical civilization. [Berdyaev refers to the French translation (Paris: Payot, 1931) of *Le tragedie del progresso* (Torino: Bocca, 1930). English translation by C. Taylor, *The Tragedies of Progress* (New York: Dutton, 1931).]

EXISTENTIAL

From "My Fellowman"

JEAN-PAUL SARTRE

■ Jean-Paul Sartre *(1905-1980) was born in Paris. A philosopher and a writer, Sartre has had the dominant influence in the development of Existentialism. In his works he expresses a passionate interest in human beings. Human beings are for him essentially free. They make themselves through their choices in life. His major work on that theme is* Being and Nothingness *(1943). Sartre fought with the French army in 1940 and was captured by the Germans. This experience tempered his claims about the absolute freedom of human beings and moved him close to a Marxist position. His work* Critique of Dialectic Reason *(1960) attempts to show the underlying harmony between Marxism and Existentialism. Nevertheless, he has been an outspoken critic of the French communist party.*

In this rich selection from Being and Nothingness, *Sartre speaks of the human being's existence as inextricably interwoven with technique. "I am the ends which I have chosen and the techniques which realize them." This is of course reminiscent of the view of another existentialist, Ortega y Gassett. Sartre adds that not only is one's being so related to technique, but in fact the external world as it appears to the individual is itself modified through techniques, for "my factual existence . . . involves my apprehension of the world and of myself through certain techniques." The collectivities to which an individual belongs (nationality, religion, and profession, among others) themselves require the use of certain techniques, so that "the only positive way which I have to exist my factual belonging to these collectivities is the use which I constantly make of the techniques which arise from them." But Sartre's final conclusion is that we are not enslaved by technique; in fact, the only possible foundation of technique is one's freedom to choose. Thus Sartre disagrees with those who argue for technological determinism.*

To live in a world haunted by my fellowman is not only to be able to encounter the Other at every turn of the road; it is also to find myself engaged in a world in which instrumental-complexes can have a meaning which my free project has not first given to them. It means also that in the midst of this world *already* provided with meaning I meet with a meaning which is *mine* and which I have not given to myself, which I discover that I "possess already." Thus when we ask what the original and contingent fact of existing in a world in which "there are" also Others can mean for our situation, the problem thus formulated demands that we study successively three layers of reality which come into play so as to constitute my concrete situation: instruments which are *already* meaningful (a station, a railroad sign, a work of art, a mobilization notice), the meaning which I discover as *already mine* (my nationality, my race, my physical appearance), and finally the Other as a center of reference to which these meanings refer.

Everything would be very simple if I belonged to a world whose meanings were revealed simply in the light of my own ends. In this case I would dispose of things as instruments or as instrumental complexes within the limits of my own choice of myself; it is this choice which would make of the mountain an obstacle difficult to overcome or a spot from which to get a good view of the landscape, etc; the problem would not be posed of knowing what meaning this mountain could have in *itself* since I would be the one by whom meanings come to reality in itself. The problem would again be very much simplified if I were a monad without doors or windows and if I merely knew in some way or other that other monads existed or were possible, each of them conferring new meanings on the things which I see. In this case, which is the one to which philosophers have too often limited themselves in their inquiry, it would be sufficient for me to hold other meanings as *possible,* and finally the plurality of meanings corresponding to the plurality of consciousnesses would coincide very simply for me with the possibility always open to me of making *another choice* of myself. But we have seen that this monadic conception conceals a hidden solipsism precisely because it is going to confuse the plurality of meanings which I can attach to the real and the plurality of meaningful systems each one of which refers to a consciousness which I am not. Moreover on the level of concrete experience this monadic description is revealed as inadequate. There exists, in fact, something in "my" world other than a plurality of possible meanings; there exist objective meanings which are given to me

□ From *Being and Nothingness,* trans. Hazel E. Barnes (New York: The Citadel Press, 1968), pp. 485-501.

as not having been brought to light by me. I, by whom meanings come to things, I find myself engaged in an *already meaningful* world which reflects to me meanings which I have not put into it.

One may recall, for example, the innumerable host of meanings which are independent of *my choice* and which I discover if I live in a city: streets, houses, shops, streetcars and buses, directing signs, warning sounds, music on the radio, *etc.* In solitude, of course, I should discover the brute and unpredictable existence—*this* rock, for example—and I should limit myself, in short, to making *there be* a rock; that is, that there should be *this* existent here and outside of it nothing. Nevertheless I should confer on it its meaning as "to be climbed," "to be avoided," "to be contemplated," *etc.* When there were the street curves, I discover a building, it is not only a brute existent which I reveal in the world; I do not only cause there to be a "this" qualified in this or that way; but the meaning of the object which is revealed then resists me and remains independent of me. I discover that the property is an apartment house, or a group of offices belonging to the Gas Company, or a prison, *etc.* The meaning here is contingent, independent of my choice; it is presented with the same indifference as the reality of the in-itself; it is made a *thing* and is not distinguished from the *quality* of the in-itself.[1] Similarly the coefficient of adversity in things is revealed to me before being experienced by me. Hosts of notices put me on my guard: "Reduce Speed. Dangerous curve," "Slow. School," "Danger," "Narrow Bridge 100 feet ahead," *etc.* But these meanings while deeply imprinted on things and sharing in their indifferent exteriority—at least in appearance—are nonetheless indications for a conduct to be adopted, and they directly concern me. I shall cross the street in the lanes indicated. I shall go into this particular shop to buy this particular instrument, and a page with directions for using it is given to buyers. Later I shall use this instrument, a pen, for example, to fill out this or that printed form under determined conditions.

Am I not going to find in all this strict limits to my freedom? If I do not follow point by point the directions furnished by others, I shall lose my bearings, I shall take the wrong street, I shall miss my train, *etc.* Moreover these notices are most often imperatives: "Enter here," "Go out here." Such is the meaning of the words "Entrance" and "Exit" painted over doorways. I obey. They come to add to the coefficient of adversity which I cause to be born in things, a strictly human coefficient of adversity. Furthermore if I submit to this organization, I depend on it. The benefits which it provides me can cease; come civil disturbance, a war, and it is always the items of prime necessity which become scarce without my having any hand in it. I am dispossessed, arrested in my projects, deprived of what is necessary in order for me to accomplish my ends. In particular we have observed that directions, instructions, orders, prohibitions, billboards are addressed to me in so far as I am just *anybody;* to the extent that I obey them, that I fall into line, I submit to the goals of a human reality which is just anybody and I realize them by just any techniques. I am therefore modified in my own being since I *am* the ends which I have chosen and the techniques which realize them—to any ends whatsoever, to any techniques whatsoever, any human reality whatsoever. At the same time since the world never appears except through the techniques which I use, the world—it also—is modified. This world, seen through the use which I make of the bicycle, the automobile, the train in order that I may traverse the world, reveals to me a countenance strictly correlative with the means which I employ; therefore it is *the countenance which the world offers to everybody.* Evidently it must follow, someone will say, that my freedom escapes me on every side; there is no longer a *situation* as the organization of a meaningful world around the free choice of my spontaneity; there is a *state* which is imposed upon me. It is this problem which we must now examine.

There is no doubt that my belonging to an inhabited world has the value of a *fact.* It refers to the original fact of the Other's presence in the world, a fact which, as we have seen, can not be deduced from the ontological structure of the for-itself.[2] And although this fact only makes our facticity more deep-rooted, it does not evolve from our facticity in so far as the latter expresses the necessity of the contingency of the for-itself. Rather we must say: the for-itself *exists in fact;* that is, its existence can not be identical with a reality engendered in conformity to a law, nor can it be identical with a free choice. And among the factual characteristics of this "facticity"—*i.e.,* among those which can neither be deduced nor proven but which simply "let themselves be seen"—there is one of these which we call the existence-in-the-world-in-the-presence-of-others. Whether this factual characteristic does or does not need to be recovered by my freedom in order to be efficacious in any manner whatsoever is what we shall discuss a little later. Yet the fact remains that on the level of techniques of appropriating the world, the very *fact* of the Other's existence results in the fact of the collective ownership of techniques. Therefore facticity is expressed on this level by the fact of my appearance in a world which is revealed to me only by collective and already constituted techniques which aim at making me apprehend the world in a form whose meaning has been defined outside of me. These techniques are going to determine my belonging to collectivities: to the *human race*, to the national collectivity, to the professional and to the family group.

It is even necessary to underscore this fact further: outside of my being-for-others—of which we shall speak later—the only positive way which I have *to exist my factual belonging* to these collectivities is the use which I constantly make of the techniques which arise from them. Belonging to the *human race* is defined by the use of very elementary and very general techniques: to know how to walk, to know how to take hold, to know how to pass judgment on the surface and the relative size of perceived objects, to know how to speak, to know how in general to distinguish the true from the false, *etc*. But we do not possess these techniques in this abstract and universal form: to know how to speak is not to know how to pronounce and understand words in general; it is to know how to speak a certain language and by it to manifest one's belonging to humanity *on the level of* the national collectivity. Moreover to know how to speak a language is not to have an abstract and pure knowledge of the language as it is defined by academic dictionaries and grammars; it is to make the language one's own across the peculiar changes and emphasis brought in by one's province, profession, and family. Thus it can be said that the *reality* of our belonging to the human is our *nationality* and that the reality of our nationality is our belonging to the family, to the region, to the profession, *etc*. in the sense that the *reality* of speech is language and that the reality of language is dialect, slang, jargon, *etc*. And conversely the *truth* of the dialect is the language, the *truth* of the language is speech. This means that the concrete techniques by which we manifest our belonging to the family and to the locality refer us to more abstract and more general structures which constitute its meaning and essence; these refer to others still more general until we arrive at the universal and perfectly simple essence of any technique whatsoever by which any being whatsoever appropriates the world.

Thus to be French, for example, is only the *truth* of being a Savoyard. But to be a Savoyard is not simply to inhabit the high valleys of Savoy; it is, among a thousand other things, to ski in the winters, to use the ski as a mode of transportation. And precisely, it is to ski according to the French method, not that of Arlberg or of Norway.[3] But since the mountain and the snowy slopes are apprehended only through a technique, this is precisely to discover the *French* meaning of ski slopes. In fact according to whether one will employ the Norwegian method, which is better for gentle slopes, or the French method which is better for steep slopes, the same slope will appear as steeper or more gentle exactly as an upgrade will appear as more or less steep to the bicyclist according to whether he will "put himself into neutral or low gear." Thus the French skier employs a French "gear" to descend the ski fields, and this "gear" reveals to him a particular type of slope wherever he may be. This is to say that the Swiss or Bavarian Alps, the Telemark, or the Jura will always offer to him a meaning, difficulties, an instrumental complex, or a complex of adversity which are purely French. Similarly it would be easy to show that the majority of attempts to define the working class amount to taking as a criterion production, consumption or a certain type of *Weltanschauung* springing out of an inferiority complex (Marx-Halbwachs-de Man); that is, in all cases certain techniques for the elaboration or the appropriation of the world across which there is offered what we shall be able to call the "proletarian countenance" with its violent oppositions, its great uniform and desert masses, its zones of shadow and its shores of light, the simple and urgent ends which illuminate it.

Now it is evident that although my belonging to a particular class or nation does not derive from my facticity as an ontological structure of my for-itself, my factual existence—*i.e.,* my birth and my place—involves my apprehension of the world and of myself through certain techniques. Now these techniques which I have not chosen confer on the world its meanings. It appears that it is no longer I who decide in terms of my ends whether the world appears to me with the simple, well-marked oppositions of the "proletarian" universe or with the innumerable interwoven nuances of the "bourgeois" world. I am not only thrown face to face with the brute existent. I am thrown into a worker's world, a French world, a world of Lorraine or the South, which offers me its meanings without my having done anything to disclose them.

Let us look more closely. We showed earlier that my nationality is only the *truth* of my belonging to a province, to a family, to a professional group. But must we stop there? If the language is only the truth of the dialect, is the dialect absolutely concrete reality? Is the professional jargon as "they" speak it, or the Alsatian dialect as a linguistic and statistical study enables us to determine its laws—is this the primary phenomenon, the one which finds its foundation in pure fact, in original contingency? Linguistic research can be mistaken here; statistics bring to light constants, phonetic or semantic changes of a given type; they allow us to reconstruct the evolution of a phoneme or a morpheme in a given period so that it appears that the *word* or the *syntactical* rule is an individual reality with its meaning and its history. And in fact individuals seem to have little influence over the evolution of language. Social facts such as invasions, great thoroughfares, commercial relations seem to be the essential causes of linguistic changes. But this is because the question is not placed on the true level of the concrete. Also we find only what we are looking for.

For a long time psychologists have observed that the *word* is not the concrete element of speech—not even the word of the dialect or the word of the family with its particular variation; the elementary structure of speech is the *sentence*. It is within the sentence, in fact, that the word can receive a real function as a designation; outside of the sentence the word is just a propositional function—when it is not a pure and simple rubric designed to group absolutely disparate meanings. Only when it appears in discourse, does it assume a "holophrastic" character, as has often been pointed out. This does not mean that the word can be limited by itself to a precise meaning but that it is integrated in a context as a secondary form in a primary form. The word therefore has only a purely *virtual* existence outside of complex and active organizations which integrate it. It can not exist "in" a consciousness or an unconscious *before* the use which is made of it: the sentence is not *made out of words*. But we need not be content with this. Paulhan has shown in *Fleurs de Tarbes* that entire sentences, "commonplaces," do not, any more than words, pre-exist the use which is made of them. They are mere commonplaces if they are looked at from the outside by a reader who recomposes the paragraph by passing from one sentence to the next, but they lose their banal and conventional character if they are placed within the point of view of the author who saw *the thing to be expressed* and who attended to the most pressing things first by producing an act of designation or re-creation without slowing down to consider the very elements of this act. If this is true, then neither the words nor the syntax, nor the "ready-made sentences" pre-exist the use which is made of them. Since the verbal unity is the meaningful sentence, the latter is a constructive act which is conceived only by a transcendence which surpasses and nihilates the given toward an end. To understand the word in the light of the sentence is *very exactly* to understand any given whatsoever in terms of the situation and to understand the situation in the light of the original ends.

To understand a sentence spoken by my companion is, in fact, to understand what he "means"—that is, to espouse his movement of transcendence, to throw myself with him toward possibles, toward ends, and to return again to the ensemble of organized means so as to understand them by their function and their end. The spoken language, moreover, is always interpreted in terms of the situation. References to the weather, to time, to place, to the environment, to the situation of the city, of the province, of the country are given before the word.[4] It is enough for me to have read the papers and to have *seen* Pierre's healthy appearance and anxious expression in order for me to understand the "Things aren't so good" with which he greets me this morning. It is not his health which "is not so good" since he has a rosy complexion, nor is it his business nor his household; it is the situation of our city or of our country. I *knew it already*. In asking him, "How goes it?", I was already outlining an interpretation of his reply; I transported myself already to the four corners of the horizon, ready to *return* from there to Pierre in order to understand him. To listen to conversation is to "speak with," not simply because we imitate in order to interpret, but because we originally project ourselves toward the possibles and because we must understand *in terms of the world*.

But if the sentence pre-exists the word, then we are referred to the *speaker* as the concrete foundation of his speech. A word can indeed seem to have a "life" of its own if one comes upon it in sentences of various epochs. This borrowed life resembles that of an object in a film fantasy; for example, a knife which by itself starts slicing a pear. It is effected by the juxtaposition of instantaneities; it is cinematographic and is constituted in universal time. But if words appear to live when one projects a semantic or morphological film, they are not going to constitute whole sentences; they are only the tracks of the passage of sentences as highways are only the tracks of the passage of pilgrims or caravans. The sentence is a project which can be interpreted only in terms of the nihilation of a given (the very one which one wishes to *designate*) in terms of a posited end (its *designation* which itself supposes other ends in relation to which it is only a means). If the given can not determine the sentence any more than the word can, if on the contrary the sentence is necessary to illuminate the given and to make the word understandable, then the sentence is a moment of the free choice of myself, and it is as such that it is understood by my companion. If a language is the reality of speech, if a dialect or jargon is the reality of language, then the reality of the dialect is the *free act* of designation by which I choose myself as *designating*. And this free act can not be an *assembling* of words. To be sure, if it were a pure assembling or words in conformity with technical prescriptions (grammatical laws), we could speak of factual limits imposed on the freedom of the speaker; these limits would be marked by the material and phonetic nature of the words, the vocabulary of the language employed, the personal vocabulary of the speaker (the *n* words which he has at his command), the "spirit of the language," *etc., etc.* But we have just shown that such is not the case. It has been maintained recently that there is a sort of living order of words, of the dynamic laws of speech, an impersonal life of the logos—in short that speech is a Nature and that to some extent man must obey it in order to make use of it as he does with Nature.[5] But this is because people in considering speech frequently will take speech that is *dead* (*i.e.*, already spoken) and infuse into it an impersonal life and force, affinities and repulsions all of which in fact have been borrowed from the personal freedom of the for-itself which spoke. People have made of speech a *language which speaks all by itself*. This is an error which should not be made with regard to speech or any other technique. If we are to make man arise in the midst of techniques which are applied all by themselves, of a language which speaks itself, of a science which constructs itself, of a city which builds itself according to its own laws, if meanings are fixed in in-itself while we preserve a human transcendence, then the role of man will be reduced to that of a pilot employing the determined forces of winds, waves, and tides in order to direct a ship. But gradually each technique in order to be directed toward human ends will require another technique; for example, to direct a boat, it is necessary to speak. Thus we shall perhaps arrive at the technique of techniques—which in turn will be applied by itself—but we shall have lost forever the possibility of meeting the technician.

If on the other hand, it is by speaking that we cause words to exist, we do not thereby suppress the *necessary technical* connections or the connections *in fact* which are articulated inside the sentence. Better yet, *we found* this necessity. But in order for it to appear, in order for words to enter into relations with one another, in order for them to latch on to one another or repulse one another, it is necessary that they be united in a synthesis which does not come from them. Suppress this synthetic unity and the block which is called "speech" disintegrates; each word returns to its solitude and at the same time loses its unity, being parcelled out among various incommunicable meanings. Thus it is within the free project of the sentence that the laws of speech are organized; it is by speaking that I make grammar. Freedom is the only possible foundation of the laws of language.

Furthermore, *for whom* do the laws of language exist? Paulhan has given the essential answer: they are not for the one who speaks, they are for the one who listens. The person who speaks is only the choice of a *meaning* and apprehends the order of the words only in so far as he *makes it*.[6] The only relations which he will grasp within this organized complex are specifically those which he has established. Consequently if we discover that two (or several) words hold between them not *one* but several defined relations and that there results from this a multiplicity of meanings which are arranged in an hierarchy or opposed to each other—all for one and the same sentence—if, in short, we discover the "Devil's share," this can be only under the two following conditions: (1) The words must have been assembled and presented by a meaningful rapprochement; (2) this synthesis must be seen from *outside*—*i.e.*, by *The Other* and in the course of a hypothetical deciphering of the possible meanings of this rapprochement. In this case, in fact, each word grasped *first* as a square of meaning is bound to another word similarly apprehended. And the rapprochement will be multivocal. The apprehension of the *true* meaning (*i.e.*, the one expressly willed by the speaker) will be able to put other meanings in the shade or subordinate them, but it will not suppress them. Thus speech, which is a free project *for me*, has specific laws *for others*. And these laws themselves can come into play only within an original synthesis.

Thus we can grasp the clear distinction between the event "sentence" and a natural event. The natural fact is produced in conformity to a law which it manifests but which is a purely external rule of production of which the considered fact is only one example. The "sentence" as an event contains within itself the law of its organization, and it is inside the free project of *designating* that legal (*i.e.*, grammatical) relations can arise between the words. In fact, there can be no laws of speaking before one speaks. And each utterance is a free project of designation issuing from the choice of a personal for-itself and destined to be interpreted in terms of the global situation of this for-itself. What is primary is the situation in terms of which I understand the *meaning* of the sentence; this meaning is not in itself to be considered as a given but rather as an end chosen in a free surpassing of means. Such is the only *reality* which the working linguist can encounter. From the standpoint of this reality a regressive analytical work will be able to bring to light certain more general and more simple structures which are like legal schemata. But these schemata which would function as laws of dialect, for example, are in themselves abstract. Far from presiding over the constitution of the sentence and being the mould into which it flows, they exist only in and through this sentence. In this sense the sentence appears as a free invention of its own laws. We find here simply the original characteristic of every situation; it is by its very surpassing of the given as such (the linguistic apparatus) that the free project of the sentence causes the given to appear as *this* given (these laws of word order and dialectal pronunciation). But the free project of the sentence is precisely a scheme to assume *this given;* it is not just any assumption but is aimed at a not yet existing end across existing means on which it confers their exact meaning as a means.

Thus the sentence is the order of words which become *these words* only by means of their very order. This is indeed what linguists and psychologists have perceived, and their embarrassment can be of use to us here as a counter-proof; they believed that they discovered a circle in the formulation of speaking, for in order to speak it is necessary to know one's thought. But how can we know this thought as a reality made explicit and fixed in concepts except precisely by speaking it? Thus speech refers to thought and thought to speech. But we understand now that there is no circle or rather that this circle—from which linguists and psychologists believed they could escape by the invention of pure psychological idols such as the verbal image or an imageless, wordless thought—is not unique with speech; it is the characteristic of the situation in general. It means nothing else but the ekstatic connection of the present, the future, and the past—that is, the free determination of the existent by the not-yet-existing and the determination of the non-yet-existing by the existent. Once we have established this fact, it will be permissible to uncover abstract operational schemata which will stand as the legal truth of the sentence: the dialectal schema—the schema of the national language—the linguistic schema in general. But these schemata far from pre-existing the concrete sentence are in themselves affected with *Unselbständigkeit* and exist always incarnated and sustained in their very incarnation by a freedom.[7]

It must be understood, of course, that speech is here only the example of one social and universal technique. The same would be true for any other technique. It is the blow of the axe which reveals the axe, it is the hammering which reveals the hammer. It will be permissible in a particular run to reveal the French method of skiing and in this method the general skill of skiing as a human possibility. But this human skill is never anything by itself alone; it exists only *potentially;* it is incarnated and manifested by the *actual* and concrete skill of the skier. This enables us to outline tentatively a solution for the relations of the individual to the race. Without the human race, mankind, there is no truth; that is certain. There would remain only an irrational and contingent swarming of individual choices to which no law could be assigned. If some sort of truth exists capable of unifying the individual choices, it is the human race which can furnish this truth for us. But if the race is the truth of the individual, it can not be a *given* in the individual without profound contradiction. As the laws of speech are sustained by and incarnated in the concrete free project of the sentence, so the human race (as an ensemble of peculiar techniques to define the activity of men) far from pre-existing an individual who would manifest it in the way that this particular fall exemplifies the law of falling bodies, is the ensemble of abstract relations sustained by the free individual choice. The for-itself in order to choose itself as a *person* effects the existence of an internal organization which the for-itself surpasses toward itself, and this internal technical organization is in it the national or the human.

Very well, someone will say. But you have dodged the question. For these linguistic organizations or techniques have not been created by the for-itself so that it may find itself; it has got them from others. The rule for the agreement of participles does not exist, I admit, outside of the free rapprochement of concrete participles in view of an end with a particular designation. But when I employ this rule, I have learned it from others; it is because others in their personal projects cause it to be that I make use of it myself. My speech is then subordinated to the speech of others and ultimately to the national speech.

We should not think of denying this fact. For that matter our problem is not to show that the for-itself is the free foundation of its being; the for-itself is free but *in condition,* and it is the relation of this condition to freedom that we are trying to define by making clear the meaning of the situation. What we have just established, in fact, is only a part of reality. We have shown that the existence of meanings which do not emanate from the for-itself can not constitute an external limit of its freedom. As a for-itself one is not man first in order to be oneself subsequently and one does not constitute oneself as oneself in terms of a human essence given *a priori*. Quite the contrary, it is in its effort to choose itself as a personal self that the for-itself sustains in existence certain social and abstract characteristics which make of it *a man* (or a woman); and the necessary connections which accompany the essential elements of man appear only on the foundation of a free choice; in this sense each for-itself is responsible in its being for the existence of a human race. But it is necessary for us again to stress the undeniable fact that the for-itself can choose itself only beyond certain meanings of which it is not the origin. Each for-itself, in fact, is a for-itself only by choosing itself beyond nationality and race just as it speaks only by choosing the designation beyond the syntax and morphemes. This "beyond" is enough to assure its total independence in relation to the structures which it surpasses; but the fact remains that it constitutes itself as *beyond* in relation to *these* particular structures. What does this mean? It means that the for-itself arises in a world which is a world for other for-itselfs. Such is the *given*. And thereby, as we have seen, the meaning of the world is *alien* to the for-itself. This means simply that each man finds himself in the presence of *meanings* which do not come into the world through him. He arises in a world which is given to him as *already looked-at,* furrowed, explored, worked over in all its meanings, and whose very contexture is already defined by these investigations. In the very act by which he unfolds his time, he temporalizes himself in a world whose temporal meaning is already defined by other temporalizations: this is the fact of simultaneity. We are not dealing here with a limit of freedom; rather it is *in this world* that the for-itself must be free; that is, it must choose itself by taking into account these circumstances and not *ad libitum*. But on the other hand, the for-itself—*i.e.,* man—in rising up *does not merely suffer* the Other's existence; he is compelled to make the Other's existence manifest to himself in the form of a choice. For it is by a choice that he will apprehend the Other as The-Other-as-subject or as The-Other-as-object.[8] Inasmuch as the Other is for him the Other-as-a-look, there can be no question of *techniques* or of foreign meanings; the for-itself experiences itself as an object in the Universe beneath the Other's look. But as soon as the for-itself by surpassing the Other toward its ends makes of him a transcendence-transcended, that which was a free surpassing of the given toward ends appears to it as meaningful, given conduct in the world (fixed in in-itself). The Other-as-object becomes an *indicator of ends* and by its own free project, the For-itself throws itself into a world in which conducts-as-objects designate ends. Thus the Other's presence as a transcended transcendence reveals *given* complexes of means to ends. And as the end decides the means and the means the end by its upsurge in the face of the Other-as-object, the For-itself causes ends in the world to be indicated to itself; it comes into a world peopled by ends. But if consequently the techniques and their ends arise in the look of the For-itself, we must necessarily recognize that it is by means of the free assumption of a position by the For-itself confronting the Other that they become *techniques*. The Other by himself alone can not cause these projects to be revealed to the For-itself as techniques; and due to this fact there *exists for the Other* in so far as he transcends himself toward his possibles, *no technique* but a concrete *doing* which is defined in terms of his individual end. The shoe-repairer who puts a new sole on a shoe does not experience himself as "in the process of applying a technique;" he apprehends the situation as demanding this or that action, that particular piece of leather, as requiring a hammer, *etc*. The For-itself as soon as it assumes a position with respect to the Other, causes techniques to arise in the world as *the conduct of the Other as a transcendence-transcended*. It is at this moment and at this moment only that there appear in the world—bourgeois and workers, French and Germans, in short, men.

Thus the For-itself is responsible for the fact that the Other's conduct is revealed in the world as techniques. The for-itself can not cause the world in which it arises to be furrowed by *this or that particular technique* (it can not make itself appear in a world which is "capitalistic" or "governed by a natural economy" or in a "parasitic civilization"), but it causes that which is lived by the Other as a free project to exist *outside* as technique; the for-itself achieves this precisely by making itself the one by whom an outside comes to the Other. Thus it is by choosing itself and by historicizing itself in the world that the For-itself historicizes the world itself and causes it to be *dated* by its techniques. Henceforth, precisely because the techniques appear as objects, the For-itself can choose to appropriate them. By arising in a world in which Pierre and Paul speak in a certain way, stick to the right when driving a bicycle or a car, *etc.*, and by constituting these free patterns of conduct into meaningful objects, the For-itself is responsible for the fact that *there is* a world in which *they* stick to the right, in which *they* speak French, *etc*. It causes the internal laws of the Other's act, which were originally founded and sustained by a freedom engaged in a project, to become now objective rules of the conduct-as-object; and these rules become universally valid for all analogous conduct, while the supporter of the conduct or the agent-as-object becomes simply *anybody*. This historization, which is the effect of the for-itself's free choice, in no way restricts its freedom; quite the contrary, it is *in this world* and no other that its freedom comes into play; it is in connection with its existence in *this* world that it puts itself into question. For to be free is not to choose the historic world in which one arises—which would have no meaning—but to choose oneself in the world whatever this may be.

In this sense it would be absurd to suppose that a certain *state* of techniques is restrictive to human possibilities. Of course a contemporary of Duns Scotus is ignorant of the use of the automobile or the airplane; but he appears as ignorant *to us* and only from our point of view because we privately apprehend him in terms of a world where the automobile and the airplane exist. For him, who has no relation of any kind with these objects and the techniques which refer to them, there exists a kind of absolute, unthinkable, and undecipherable nothingness. Such a nothingness *can in no way limit* the For-itself which is choosing itself; it can not be apprehended as a lack, no matter how we consider it. The For-itself which historicizes itself in the time of Duns Scotus therefore nihilates itself in the heart of a fullness of being—that is, of a world which like ours is *everything which it can be*. It would be absurd to declare that the Albigenses lacked heavy artillery to use in resisting Simon de Montfort; for the Seigneur de Trencavel or the Comte de Toulouse chose themselves such as they were in a world in which artillery had no place; they viewed politics in that world; they made plans for military resistance in that world; they chose themselves as sympathizers with the Cathari *in that world;* and as they were only what they chose to be, they were *absolutely* in a world as absolutely full as that of the Panzer-divisionen or of the R.A.F.

What is true for material techniques applies as well to more subtle techniques. The fact of existing as a petty noble in Languedoc at the time of Raymond VI is not *determining* if it is placed *in the feudal world* in which this lord exists and in which he chooses himself. It appears as privative only if we commit the error of considering this division of *Francia* and of the Midi from the actual point of view of French unity. The feudal world offered to the vassal lord of Raymond VI infinite possibilities of choice; we do not possess more. A question just as absurd is often posited in a kind of utopian dream: what would Descartes have been if he had known of contemporary physics? This is to suppose that Descartes possesses an *a priori* nature more or less limited and altered by the state of science in his time and that we could transport this brute nature to the contemporary period in which it would react to more extensive and more exact knowledge. But this is to forget that Descartes is what he has chosen to be, that he is an absolute choice of himself from the standpoint of a world of various kinds of knowledge and of techniques which this choice both assumes and illuminates. Descartes is an absolute upsurge at an absolute date and is perfectly unthinkable at another date, for he has made his date by making himself. It is he and not another who has determined the exact state of the mathematical knowledge immediately before him, not by an empty inventory which would be made from no point of view and would be related to no axis of coordination, but by establishing the principles of analytical geometry—that is, by inventing precisely the axis of coordinates which would permit us to define the state of this knowledge. Here again it is free invention and the future which enable us to illuminate the present; it is the perfecting of the technique in view of an end which enables us to evaluate the state of the technique.

Thus when the For-itself affirms itself in the face of the Other-as-object, by the same stroke it reveals *techniques*. Consequently it can appropriate them—that is, *interiorize* them. But suddenly there are the following consequences: (1) By employing a technique, the For-itself surpasses the technique toward its own end; it is always beyond the technique which it employs. (2) The technique which was originally a pure, meaningful conduct fixed in some Other-as-object, now, because it is interiorized, loses its character as a technique and is integrated purely and simply in the free surpassing of the given toward ends; it is recovered and sustained by the freedom which founds it exactly as dialect or speech is sustained by the free project of the sentence. Feudalism as a technical relation between man and man does not exist; it is only a pure abstract, sustained and surpassed by the thousands of individual projects of a particular man who is a liege in relation to his lord. By this we by no means intend to arrive at a sort of historical nominalism. We do not mean that feudalism is the sum of the relations of vassals and suzerains. On the contrary, we hold that it is the abstract structure of these relations; every project of a man of this time must be realized as a surpassing toward the concrete of this abstract moment. It is therefore not necessary to generalize in terms of numerous detailed experiences in order to establish the principles of the feudal technique; this technique exists necessarily and completely in each individual conduct, and it can be brought to light in each case. But it is there only to be surpassed. In the same way the For-itself can not be a person—*i.e.,* choose the ends which it is—without being a man or woman, a member of a national collectivity, of a class, of family, *etc.* But these are abstract structures which the For-itself sustains and surpasses by its project. It makes itself French, a man of a southern province, a workman to order to be *itself* at the horizon of these determinations. Similarly the world which is revealed to the For-itself appears as provided with certain meanings correlative with the techniques adopted. It appears as a world-for-the-Frenchman, a world-for-the-worker, *etc.,* with all the characteristics which would be expected. But these characteristics do not possess *Selbständigkeit.* The world which allows itself to be revealed as French, proletarian, *etc.,* is before all else a world which is illuminated by the For-itself's own ends, its own world.

Nevertheless the Other's existence brings a factual limit to my freedom. This is because of the fact that by means of the upsurge of the Other there appear certain determinations which I *am* without having chosen them. Here I am—Jew, or Aryan, handsome or ugly, one-armed, *etc.* All this I am *for the Other* with no hope of apprehending this meaning which I have *outside* and, still more important, with no hope of changing it. Speech alone will inform me of what I am; again this will never be except as the object of an empty intention; any intuition of it is forever denied me. If my race or my physical appearance were only an image in the Other or the Other's opinion of me, we should soon have done with it; but we have seen that we are dealing with objective characteristics which define me in my being-for-others. As soon as a freedom other than mine arises confronting me, I begin to exist in a new dimension of being; and this time it is not a question of my conferring a meaning on brute existents or of accepting responsibility on my own account for the meaning which Others have conferred on certain objects. It is I myself who see a meaning conferred upon me, and I do not have the recourse of accepting the responsibility for this meaning which I have since it can not be given to me except in the form of an empty indication. Thus something of myself—according to this new dimension—exists in the manner of the *given;* at least *for me,* since this being which I am *is suffered,* it *is* without *being existed.* I learn of it and suffer it in and through the relations which I enter into with others, in and through their conduct with regard to me. I encounter this being at the origin of a thousand prohibitions and a thousand resistances which I bump up against at each instant: Because I am a *minor* I shall not have this or that privilege. Because *I am a Jew* I shall be deprived—in certain societies—of certain possibilities, *etc.* Yet I am unable *in any way* to feel myself as a Jew or as a minor or as a Pariah. It is at this point that I can react against these interdictions by declaring that race, for example, is purely and simply a collective fiction, that only individuals exist. Thus here I suddenly encounter the total alienation of my person: I am something which I have not chosen to be. What is going to be the result of this for the situation?

We must recognize that we have just encountered a *real* limit to our freedom—that is, a way of being which is imposed on us without our freedom being its foundation. Still it is necessary to understand this: the limit imposed does not come from the *action* of others. In a preceding chapter we observed that even torture does not dispossess us of our freedom; when we give in, we do so *freely.* In a more general way the encounter with a prohibition in my path ("No Jews allowed here," or "Jewish restaurant. No Aryans allowed," *etc.*) refers us to the case considered earlier (collective techniques), and this prohibition can have meaning only on and through the foundation of my free choice. In fact according to the free possibilities which I choose, I can disobey the prohibition, pay no attention to it, or, on the contrary, confer upon it a coercive value which it can hold only because of the weight which I attach to it. Of course the prohibition fully retains its character as an "emanation from an alien will;" of course it has for its specific structure the fact of *taking me for an object* and thereby manifesting a transcendence which transcends me. Still the fact remains that it is not incarnated in *my* universe, and it loses its peculiar force of compulsion only within the limits of my own choice and according to whether under any circumstances I prefer life to death or whether, on the contrary, I judge that in certain particular cases death is preferable to certain kinds of life, *etc.* The true limit of my freedom lies purely and simply in the very fact that an Other apprehends me as the Other-as-object and in that second corollary fact that my situation ceases for the Other to be a situation and becomes an objective form in which I exist as an objective structure. It is this alienating process of making an object of my situation which is the constant and specific limit of my situation, just as the making an object of my being-for-itself in being-for-others is the limit of my being. And it is precisely these two characteristic limits which represent the boundaries of my freedom.

In short, by the fact of the Other's existence, I exist in a situation which *has an outside* and which due to this very fact has a dimension of alienation which I can in no way remove from the situation any more than I can act directly upon it. This limit to my freedom is, as we see, posited by the Other's pure and simple existence—that is, by the *fact* that my transcendence exists for a transcendence. Thus we grasp a truth of great importance: we saw earlier, keeping ourselves within the compass of existence-for-itself, that only my freedom can limit my freedom; we see now, when we include the Other's existence in our considerations, that my freedom on this new level finds its limits also in the existence of the Other's freedom. Thus on whatever level we place ourselves, the only limits which a freedom can encounter are found in freedom. Just as thought according to Spinoza can be limited only by thought, so freedom can be limited only by freedom. Its limitation as internal finitude stems from the *fact* that it can not not-be freedom—that is, it is condemned to be free; its limitation as external finitude stems from the *fact* that being freedom, it *is* for other freedoms, freedoms which freely apprehend it in the light of their own ends.

NOTES

1. The in-itself is that which is what it is. Ortega, in the first selection by him in Part Two, explains it as that which is given its existence, like the stone or the plant [ed. note].
2. The for-itself is that which is not what it is, and is what it is not. Ortega explains it as that which is given the abstract possibility of existence, but not the reality—like

man, who is a project, something which is not yet but aspires to be [ed. note].

3. This is a simplification: There are influences and interferences in the matter of technique; the Arlberg method has been prevalent with us for a long time. The reader will easily be able to re-establish the facts in their complexity.
4. We are intentionally oversimplifying. There are influences and interferences. But the reader will be able to re-establish the facts in their complexity. (The French text does not indicate whether this footnote belongs with this sentence or with a sentence in the preceding paragraph. The exact position can hardly be important. Tr.)
5. Brice-Parain: *Essai sur le logos platonicien.*
6. I am simplifying: one can also learn one's own thought from one's sentence. But this is because it is possible to a certain extent to adopt with respect to the sentence the point of view of the Other—exactly as in the case of one's own body.
7. "Unselbständigkeit" may be translated here as "incompleteness" or "the lack of independence." (ed. note).
8. We shall see later that the problem is more complex. But these remarks are sufficient for the present.

EXISTENTIAL

The stages of technology

JOSÉ ORTEGA Y GASSET

■ Ortega *presents in this selection a three-stage theory of the evolution of technology. He rejects off-hand the appearance of inventions as a criterion for the demarcation of these stages. Instead, he proposes what amounts to a theory of the evolution of man's consciousness of his relation to technology. The relation ascends from the unconscious level—that is, the level at which man is unaware of his technological abilities—all the way to the fully conscious level, at which he is completely aware of his technological abilities.*

The first level is a primitive stage characterized by "the technology of chance." In this stage man does not conceive of himself as homo faber; *thus "all primitive technology smacks of magic." This stage is succeeded by a transitional one characterized by the "technology of the craftsman." In this stage man is aware of technological abilities as gifts granted to craftsmen who make them full-time jobs. In the highest stage, characterized by the "technology of the technician," man realizes that his technological abilities belong to him as human being, not to nature and not to a select group of craftsmen. He realizes that they are "a source of practically unlimited human activity."*

Ortega nevertheless issues the following warning: "Technology for all its being a practically unlimited capacity will irretrievably empty the lives of those who are resolved to stake everything on their faith in it and it alone."

TECHNOLOGY OF CHANCE

The subject is difficult. It took me some time to decide upon the principle best suited to distinguish periods of technology. I do not hesitate to reject the one readiest to hand, viz., that we should divide the evolution according to the appearance of certain momentous and characteristic inventions. All I have said in this essay aims to correct the current error of regarding such or such a definite invention as the thing which matters in technology. What really matters and what can bring about a fundamental advance is a change in the general character of technology. No single invention is of such caliber as to bear comparison with the tremendous mass of the integral evolution. We have seen that magnificient advances have been achieved only to be lost again, whether they disappeared completely or whether they had to be rediscovered.

Nay more, an invention may be made sometime and somewhere and still fail to take on its true technical significance. Gunpowder and the printing press, unquestionably two discoveries of great pith and moment, were known in China for centuries without being of much use. It is not before the fifteenth century in Europe that gunpowder and the printing press, the former probably in Lombardy, the latter in Germany, became historical powers. With this in view, when shall we say they were invented? No doubt, they grew effective in history only when they appeared incorporated in the general body of late medieval technology, serving the purposes of the program of life operative in that age. Firearms and the

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printing press are contemporaries of the compass. They all bear the same marks, so characteristic, as we shall shortly see, of that hour between Gothic and Renaissance, the scientific endeavors of which culminated in Copernicus. The reader will observe that, each in its own manner, they establish contact between man and things at a distance from him. They belong to the instruments of the *actio in distans,* which is at the root of modern technology. The cannon brings distant armies into immediate touch with each other. The compass throws a bridge between man and the cardinal points. The printing press brings the solitary writer into the presence of the infinite orbit of possible readers.

The best principle of delimiting periods in technical evolution is, to my judgment, furnished by the relation between man and technology, in other words by the conception which man in the course of history held, not of this or that particular technology but of the technical function as such. In applying this principle we shall see that it not only clarifies the past, but also throws light on the question we have asked before: how could modern technology give birth to such radical changes, and why is the part it plays in human life unparalleled in any previous age?

Taking this principle as our point of departure we come to discern three main periods in the evolution of technology: technology of chance; technology of the craftsman; technology of the technician.

What I call technology of chance, because in it chance is the engineer responsible for the invention, is the primitive technology of pre- and protohistoric man and of the contemporary savage, viz., of the least-advanced groups of mankind—as the Vedas in Ceylon, the Semang in Borneo, the pigmies in New Guinea and Central Africa, the Australian Negroes, etc.

How does primitive man conceive technology? The answer is easy. He is not aware of his technology as such; he is unconscious of the fact that there is among his faculties one which enables him to refashion nature after his desires.

The repertory of technical acts at the command of primitive man is very small and does not form a body of sufficient volume to stand out against, and be distinguished from, that of his natural acts, which is incomparably more important. That is to say, primitive man is very little man and almost all animal. His technical acts are scattered over and merged into the totality of his natural acts and appear to him as part of his natural life. He finds himself with the ability to light a fire as he finds himself with the ability to walk, swim, use his arms . . . His natural acts are a given stock fixed once and for all; and so are his technical. It does not occur to him that technology is a means of virtually unlimited changes and advances.

The simplicity and scantiness of these pristine technical acts account for their being executed indiscriminately by all members of the community, who all light fires, carve bows and arrows, and so forth. The one differentiation noticeable very early is that women perform certain technical functions and men certain others. But that does not help primitive man to recognize technology as an isolated phenomenon. For the repertory of natural acts is also somewhat different in men and women. That the woman should plow the field—it was she who invented agriculture—appears as natural as that she should bear the children.

Nor does technology at this stage reveal its most characteristic aspect, that of invention. Primitive man is unaware that he has the power of invention; his inventions are not the result of a premeditated and deliberate search. He does not look for them; they seem rather to look for him. In the course of his constant and fortuitous manipulation of objects he may suddenly and by mere chance come upon a new useful device. While for fun or out of sheer restlessness he rubs two sticks together a spark springs up, and a vision of new connections between things will dawn upon him. The stick, which hitherto has served as weapon or support, acquires the new aspect of a thing producing fire. Our savage will be awed, feeling that nature has inadvertently loosed one of its secrets before him. Since fire had always seemed a godlike power, arousing religious emotions, the new fact is prone to take on a magic tinge. All primitive technology smacks of magic. In fact, magic, as we shall shortly see, is nothing but a kind of technology, albeit a frustrated and illusory one.

Primitive man does not look upon himself as the inventor of his inventions. Invention appears to him as another dimension of nature, as part of nature's power to furnish him—

nature furnishing man, not man nature—with certain novel devices. He feels no more responsible for the production of his implements than for that of his hands and feet. He does not conceive of himself as *homo faber*. He is therefore very much in the same situation as Mr. Koehler's monkey when it suddenly notices that the stick in his hands may serve an unforeseen purpose. Mr. Koehler calls this the "aha-impression" after the exclamation of surprise a man utters when coming upon a startling new relation between things. It is obviously a case of the biological law of trial and error applied to the mental sphere. The infusoria "try" various movements and eventually find one with favorable effects on them which they consequently adopt as a function.

The inventions of primitive man, being, as we have seen, products of pure chance, will obey the laws of probability. Given the number of possible independent combinations of things, a certain possibility exists of their presenting themselves some day in such an arrangement as to enable man to see preformed in them a future implement.

TECHNOLOGY AS CRAFTSMANSHIP—TECHNOLOGY OF THE TECHNICIAN

We come to the second stage, the technology of the artisan. This is the technology of Greece, of preimperial Rome, and of the Middle Ages. Here are in swift enumeration some of its essential features.

The repertory of technical acts has grown considerably. But—and this is important—a crisis and setback, or even the sudden disappearance of the principal industrial arts, would not yet be a fatal blow to material life in these societies. The life people lead with all these technical comforts and the life they would have to lead without them are not so radically different as to bar, in case of failure or checks, retreat to a primitive or almost primitive existence. The proportion between the technical and the nontechnical is not yet such as to make the former indispensable for the supporting of life. Man is still relying mainly on nature. At least, and that is what matters, so he himself feels. When technical crises arise he does therefore not realize that they will hamper his life, and consequently fails to meet them in time and with sufficient energy.

Having made this reservation we may now state that technical acts have by this time enormously increased both in number and in complexity. It has become necessary for a definite group of people to take them up systematically and make a full-time job of them. These people are the artisans. Their existence is bound to help man become conscious of technology as an independent entity. He sees the craftsman at work—the cobbler, the blacksmith, the mason, the saddler—and therefore comes to think of technology in terms and in the guise of the technician, the artisan. That is to say, he does not yet know that there is technology, but he knows that there are technicians who perform a peculiar set of activities which are not natural and common to all men.

Socrates in his struggle, which is so appallingly modern, with the people of his time began by trying to convince them that technology is not the same as the technician, that it is an abstract entity of its own not to be mixed up with this or that concrete man who possesses it.

At the second stage of technology everybody knows shoemaking to be a skill peculiar to certain men. It can be greater or smaller and suffer slight variations as do natural skills, running for instance, or swimming or, better still, the flying of a bird, the charging of a bull. That means shoemaking is now recognized as exclusively human and not natural, i.e., animal; but it is still looked upon as a gift granted and fixed once and for all. Since it is something exclusively human it is extranatural, but since it is something fixed and limited, a definite fund not admitting of substantial amplification, it partakes of nature; and thus technology belongs to the nature of man. As man finds himself equipped with the unexchangeable system of his bodily movements, so he finds himself equipped with the fixed system of the "arts." For this is the name technology bears in nations and epochs living on the technical level in question; and this is the original meaning of the Greek word *techne*.

The way technology progresses might disclose that it is an independent and, in principle, unlimited function. But, oddly enough, this fact becomes even less apparent in this than in the primitive period. After all, the few primitive inventions, being so fundamental, must have stood out melodramatically against the workaday routine of animal habits. But in craftsmanship there is no room whatever for a sense of invention. The artisan must learn thoroughly in long apprenticeship—it is the time of masters and apprentices—elaborate usages handed down by long tradition. He is governed by the norm that man must bow to tradition as such. His mind is turned towards the past and closed to novel possibilities. He follows the established routine. Even such modifications and improvements as may be brought about in his craft through continuous and therefore imperceptible shifts present themselves not as fundamental novelties, but rather as differences of personal style and skill. And these styles of certain masters again will spread in the forms of schools and thus retain the outward character of tradition.

We must mention another decisive reason why the idea of technology is not at this time separated from the idea of the person who practices it. Invention has as yet produced only tools and not machines. The first machine in the strict sense of the word—and with it I anticipate the third period—was the weaving machine set up by Robert in 1825. It is the first machine because it is the first tool that works by itself, and by itself produces the object. Herewith technology ceases to be what it was before, handiwork, and becomes mechanical production. In the crafts the tool works as a complement of man; man with his natural actions continues to be the principal agent. In the machine the tool comes to the fore, and now it is no longer the machine that serves man but man who waits on the machine. Working by itself, emancipated from man, the machine, at this stage, finally reveals that technology is a function apart and highly independent of natural man, a function which reaches far beyond the bounds set for him. What a man can do with his fixed animal activities we know beforehand; his scope is limited. But what the machine man is capable of inventing may do, is in principle unlimited.

One more feature of craftsmanship remains to be mentioned which helps to conceal the true character of technology. I mean this: technology implies two things. First, the invention of a plan of activity, of a method or procedure—*mechane,* said the Greeks—and, secondly, the execution of this plan. The former is technology strictly speaking, the latter consists merely in handling the raw material. In short, we have the technician and the worker who between them, performing very different functions, discharge the technical job. The craftsman is both technician and worker; and what appears first is a man at work with his hands, and what appears last, if at all, is the technology behind him. The dissociation of the artisan into his two ingredients, the worker and the technician, is one of the principal symptoms of the technology of the third period.

We have anticipated some of the traits of this technology. We have called it the technology of the technician. Man becomes clearly aware that there is a capacity in him which is totally different from the immutable activities of his natural or animal part. He realizes that technology is not a haphazard discovery, as in the primitive period; that it is not a given and limited skill of some people, the artisans, as in the second period; that it is not this or that definite and therefore fixed "art"; but that it is a source of practically unlimited human activity.

This new insight into technology as such puts man in a situation radically new in his whole history and in a way contrary to all he has experienced before. Hitherto he has been conscious mainly of all the things he is unable to do, i.e., of his deficiencies and limitations. But the conception our time holds of technology—let the reader reflect a moment on his own—places us in a really tragicomic situation. Whenever we imagine some utterly extravagant feat, we catch ourselves in a feeling almost of apprehension lest our reckless dream—say a voyage to the stars—should come true. Who knows but that tomorrow morning's paper will spring upon us the news that it has been possible to send a projectile to the moon by imparting to it a speed great enough to overcome the gravitational attraction. That is to say, present-day man is secretly frightened by his own omnipotence. And this may be another reason why he does not know what he is. For finding himself in principle capable of being almost anything makes it all the harder for him to know what he actually is.

In this connection I want to draw attention to a point which does not properly belong here, that technology for all its being a practically unlimited capacity will irretrievably empty the lives of those who are resolved to stake everything on their faith in it and it alone. To be an engineer and nothing but an engineer means to be potentially everything and actually nothing. Just because of its promise of unlimited possibilities technology is an empty form like the most formalistic logic and is unable to determine the content of life. That is why our time, being the most intensely technical, is also the emptiest in all human history.

RELATION BETWEEN MAN AND TECHNOLOGY IN OUR TIME—THE ENGINEER IN ANTIQUITY

This third stage of technical evolution, which is our own, is characterized by the following features:

Technical acts and achievements have increased enormously. Whereas in the Middle Ages—the era of the artisan—technology and the nature of man counter-balanced each other and the conditions of life made it possible to benefit from the human gift of adapting nature to man without denaturalizing man, in our time the technical devices outweigh the natural ones so gravely that material life would be flatly impossible without them. This is no manner of speaking, it is the literal truth. In *The Revolt of the Masses* I drew attention to the most noteworthy fact that the population of Europe between 500 and 1800 A.D., i.e., for thirteen centuries, never exceeded 180 millions; whereas by now, in little over a century, it has reached 500 millions, not counting those who have emigrated to America. In one century it has grown nearly three and a half times its size. If today 500 million people can live well in a space where 180 lived badly before, it is evident that, whatever the minor causes, the immediate cause and most necessary condition is the perfection of technology. Were technology to suffer a setback, millions of people would perish.

Such fecundity of the human animal could occur only after man had succeeded in interposing between himself and nature a zone of exclusively technical provenance, solid and thick enough to form something like a supernature. Present-day man—I refer not to the individual but to the totality of men—has no choice of whether to live in nature or to take advantage of this supernature. He is as irremediably dependent on, and lodged in, the latter as primitive man is in his natural environment. And that entails certain dangers. Since present-day man, as soon as he opens his eyes to life, finds himself surrounded by a superabundance of technical objects and procedures forming an artificial environment of such compactness that primordial nature is hidden behind it, he will tend to believe that all these things are there in the same way as nature itself is there without further effort on his part: that aspirin and automobiles grow on trees like apples. That is to say, he may easily lose sight of technology and of the conditions—the moral conditions, for example—under which it is produced and return to the primitive attitude of taking it for the gift of nature which is simply there. We thus have the curious fact that, at first, the prodigious expansion of technology made it stand out against the sober background of man's natural activities and allowed him to gain full sight of it, whereas by now its fantastic progress threatens to obscure it again.

Another feature helping man to discover the true character of his own technology we found to be the transition from mere tools to machines, i.e., mechanically working apparatus. A modern factory is a self-sufficient establishment waited on occasionally by a few persons of very modest standing. In consequence, the technician and the worker, who were united in the artisan, have been separated and the technician has grown to be the live expression of technology as such—in a word, the engineer.

Today technology stands before our mind's eye for what it is, apart, unmistakable, isolated, and unobscured by elements other than itself. And this enables certain persons, called engineers, to devote their lives to it. In the paleolithic age or in the Middle Ages technology, that is invention, could not have been a profession because man was ignorant of his own inventive power. Today the engineer embraces as one of the most normal and firmly established forms of activity the occupation of inventor. In contrast to the savage, he knows before he begins to invent that he is capable of doing so, which means that he has "technology" before he has "a technology." To this degree and in this concrete sense our previous assertion holds that technologies are nothing but concrete realizations of the general technical functions of man. The engineer need not wait for chances and favorable odds; he is sure to make discoveries. How can he be?

The question obliges us to say a word about the technique of technology. To some people technique and nothing else is technology. They are right in so far as without technique—the intellectual method operative in technical creation—there is no technology. But with technique alone there is none either. As we have seen before, the existence of a capacity is not enough to put that capacity into action.

I should have liked to talk at leisure and in detail about both present and past techniques of technology. It is perhaps the subject in which I myself am most interested. But it would have been a mistake to let our investigations gravitate entirely around it. Now that this essay is breathing its last I must be content to give the matter brief consideration—brief, yet, I hope, sufficiently clear.

No doubt, technology could not have expanded so gloriously in these last centuries, nor the machine have replaced the tool, nor the artisan have been split up into his components, the worker and the engineer, had not the method of technology undergone a profound transformation.

Our technical methods are radically different from those of all earlier technologies. How can we best explain the diversity? Perhaps through the following question: now would an engineer of the past, supposing he was a real engineer and his invention was not due to chance but deliberately searched for, go about his task? I will give a schematic and therefore exaggerated example which is, however, historical and not fictitious. The Egyptian architect who built the pyramid of Cheops was confronted with the problem of lifting stone blocks to the highest parts of the monument. Starting as he needs must from the desired end, namely to lift the stones, he looked around for devices to achieve this. "This," I have said, meaning he is concerned with the result as a whole. His mind is absorbed by the final aim in its integrity. He will therefore consider as possible means only such procedures as will bring about the total result at once, in one operation that may take more or less time but which is homogeneous in itself. The unbroken unity of the end prompts him to look for a similarly uniform and undifferentiated means. This accounts for the fact that in the early days of technology the instrument through which an aim is achieved tends to resemble the aim itself. Thus in the construction of the pyramid the stones are raised to the top over another pyramid, an earthen pyramid with a wider base and a more gradual slope, which abuts against the first. Since a solution found through this principle of similitude—*similia similibus*—is not likely to be applicable in many cases, the engineer has no general rule and method to lead him from the intended aim to the adequate means. All he can do is to try out empirically such possibilities as offer more or less hope of serving his purpose. Within the circle defined by his special problem he thus falls back into the attitude of the primitive inventor.

HEGELIAN

Lordship and bondage

G. W. F. HEGEL

■ Georg Wilhelm Friedrich Hegel *(1770-1831) was born in Stuttgart. He was an idealist philosopher who had an impact on almost every well-known philosopher who succeeded him. He attended a theological seminary at the University of Tübingen. After his graduation he worked for a while as resident tutor for an aristocratic family. In 1800 he moved to Jena, where he accepted a teaching post. It was in Jena that he wrote his most famous book,* The Phenomenology of Mind *(1807). In this work he articulated a complex theory of consciousness. According to Hegel, the Mind (or Absolute Spirit) is the ultimate reality. The experience of the diversity and separateness of material entities in the world only reflects one stage of consciousness in the long journey of the self toward complete self-consciousness. When that ultimate stage is reached, the self will experience itself to be at one with Reality, the infinite Mind.*

In the famous passage that appears here, Hegel discusses the master-slave relationship. The basis of the relationship is the fact that a self-consciousness desires the recognition of another self-consciousness in order to become certain of itself as a true being. The most primitive mode of achieving such recognition is for the self-consciousness to wage a struggle till death with the opposing self-consciousness. For "they prove themselves and each other through a life-and-death struggle." But the end result of such an approach is the destruction of the other self-consciousness, and because of its destruction it is no longer able to supply the necessary recognition. Thus this approach fails.

A higher mode of achieving the needed recognition preserves the life of the other self-consciousness but denies it its independence. Thus the master-slave relationship emerges. But this relationship is not completely satisfactory either. The master again becomes unhappy with his victory, for he realizes that he has only achieved the recognition of a dependent *self-consciousness. On the other hand, the slave through his toil discovers his own independence. Work gives him a feeling of power, because through his labor he gives objects their form. Hegel explains: "This activity giving shape and form, is at the same time the individual existence . . . which now in the work it does is externalized and passes into the condition of permanence," thus apprehending itself directly as an independent being. This means that while the master depends on the slave for the latter's recognition and his mediation with the world of objects in order to assure the master of the certainty of his true being, the slave obtains that assurance directly through his labor. The relationship has been reversed. The master is now dependent; the slave is not, having been liberated through his labor.*

We have here, once more, a description of the evolution of self-consciousness. This evolution is again seen as being related to man's activities as homo faber. *To this extent Ortega and Hegel agree. But while for Ortega fabrication (including autofabrication) defines the very being of a person, for Hegel it liberates him and thus enables him to apprehend his true being. In discussing the decision to fight till death (a form of autofabrication) Hegel says: "The individual, who has not staked his life, may, no doubt, be recognized as a Person; but he has not attained the truth of this recognition as an* independent *self-consciousness"* [*emphasis added*].

Self-consciousness exists in itself and for itself, in that, and by the fact that it exists for another self-consciousness; that is to say, it *is* only by being acknowledged or "recognized". The conception of this its unity in its duplication, of infinitude realizing itself in self-consciousness, has many sides to it and encloses within it elements of varied significance. Thus its moments must on the one hand be strictly kept apart in detailed distinctiveness, and, on the other, in this distinction must, at the same time, also be taken as not distinguished, or must always be accepted and understood in their opposite sense. This double meaning of what is distinguished lies in the nature of self-consciousness:—of its being infinite, or directly the opposite of the determinateness in which it is fixed. The detailed exposition of the notion of this spiritual unity in its duplication will bring before us the process of Recognition.

Self-consciousness has before it another self-consciousness; it has come outside itself. This has a double significance. First it has lost its own self, since it finds itself as an *other* being; secondly, it has thereby sublated[1] that other, for it does not regard the other as essentially real, but sees its own self in the other.

It must cancel this its other. To do so is the sublation of that first double meaning, and is therefore a second double meaning. First, it must set itself to sublate the other independent

□From *The Phenomenology of Mind.* Reprinted with the permission of Humanities Press, Inc., Atlantic Highlands, New Jersey.

being, in order thereby to become certain of itself as true being, secondly, it thereupon proceeds to sublate its own self, for this other is itself.

This sublation in a double sense of its otherness in a double sense is at the same time a return in a double sense into its self. For, firstly, through sublation, it gets back itself, because it becomes one with itself again through the cancelling of *its* otherness; but secondly, it likewise gives otherness back again to the other self-consciousness, for it was aware of being in the other, it cancels this its own being in the other and thus lets the other again go free.

This process of self-consciousness in relation to another self-consciousness has in this manner been represented as the action of one alone. But this action on the part of the one has itself the double significance of being at once its own action and the action of that other as well. For the other is likewise independent, shut up within itself, and there is nothing in it which is not there through itself. The first does not have the object before it only in the passive form characteristic primarily of the object of desire, but as an object existing independently for itself, over which therefore it has no power to do anything for its own behoof, if that object does not *per se* do what the first does to it. The process then is absolutely the double process of both self-consciousnesses. Each sees the other do the same as itself; each itself does what it demands on the part of the other, and for that reason does what it does, only so far as the other does the same. Action from one side only would be useless, because what is to happen can only be brought about by means of both.

The action has then a *double entente* not only in the sense that it is an act done to itself as well as to the other, but also in the sense that the act *simpliciter* is the act of the one as well as of the other regardless of their distinction.

In this movement we see the process repeated which came before us as the play of forces; in the present case, however, it is found in consciousness. What in the former had effect only for us [contemplating experience], holds here for the terms themselves. The middle term is self-consciousness which breaks itself up into the extremes; and each extreme is this interchange of its own determinateness, and complete transition into the opposite. While *qua* consciousness, it no doubt comes outside itself, still, in being outside itself, it is at the same time restrained within itself, it exists for itself, and its self-externalization is for consciousness. *Consciousness* finds that it immediately is and is not another consciousness, as also that this other is for itself only when it cancels itself as existing for itself, and has self-existence only in the self-existence of the other. Each is the mediating term to the other, through which each mediates and unites itself with itself; and each is to itself and to the other an immediate self-existing reality, which, at the same time, exists thus for itself only through this mediation. They recognize themselves as mutually recognizing one another.

This pure conception of recognition, of duplication of self-consciousness within its unity, we must now consider in the way its process appears for self-consciousness. It will, in the first place, present the aspect of the disparity of the two, or the break-up of the middle term into the extremes, which, *qua* extremes, are opposed to one another, and of which one is merely recognized, while the other only recognizes.

Self-consciousness is primarily simple existence for self, self-identity by exclusion of every other form itself. It takes its essential nature and absolute object to be Ego; and in this immediacy, in this bare fact of its self-existence, it is individual. That which for it is other stands as unessential object, as object with the impress and character of negation. But the other is also a self-consciousness; an individual makes its appearance in antithesis to an individual. Appearing thus in their immediacy, they are for each other in the manner of ordinary objects. They are independent individual forms, modes of consciousness that have not risen above the bare level of life (for the existent object here has been determined as life). They are, moreover, forms of consciousness which have not yet accomplished for one another the process of absolute abstraction, of uprooting all immediate existence, and of being merely the bare, negative fact of self-identical consciousness; or, in other words, have not yet revealed themselves to each other as existing purely for themselves, i.e., as self-consciousness. Each is indeed certain of its own self, but not of the other, and hence its own certainty of itself is still without truth. For its truth would be merely that its own individual existence for itself would be shown to it to be an independent object, or, which is the same thing, that the object would be exhibited as this pure certainty of itself. By the notion of recognition, however, this is not possible, except in the form that as the other is for it, so it is for the other; each in its self through its own action and again through the action of the other achieves this pure abstraction of existence for self.

The presentation of itself, however, as pure abstraction of self-consciousness consists in showing itself as a pure negation of its objective form, or in showing that it is fettered to no determinate existence, that it is not bound at all by the particularity everywhere characteristic of existence as such, and is *not* tied up with life. The process of bringing all this out involves a twofold action—action on the part of the other and action on the part of itself. In so far as it is the other's action, each aims at the destruction and death of the other. But in this there is implicated also the second kind of action, self-activity; for the former implies that it risks its own life. The relation of both self-consciousnesses is in this way so constituted that they prove themselves and each other through a life-and-death struggle. They must enter into this struggle, for they must bring their certainty of themselves, the certainty of being for themselves, to the level of objective truth, and make this a fact both in the case of the other and in their own case as well. And it is solely by risking life that freedom is obtained; only thus is it tried and proved that the essential nature of self-consciousness is not bare existence, is not the merely immediate form in which it at first makes its appearance, is not its mere absorption in the expanse of life. Rather it is thereby guaranteed that there is nothing present but what might be taken as a vanishing moment—that self-consciousness is merely pure self-existence, being-for-self. The individual, who has not staked his life, may, no doubt, be recognized as a Person; but he has not attained the truth of this recognition as an independent self-consciousness. In the same way each must aim at the death of the other, as it risks its own life thereby; for that other is to it of no more worth than itself; the other's reality is presented to the former as an external other, as outside itself; it must cancel that externality. The other is a purely existent consciousness and entangled in manifold ways; it must view its otherness as pure existence for itself or as absolute negation.

This trial by death, however, cancels both the truth which was to result from it, and therewith the certainty of self altogether. For just as life is the natural "position" of consciousness, independence without absolute negativity, so death is the natural "negation" of consciousness, negation without independence, which thus remains without the requisite significance of actual recognition. Through death, doubtless, there has arisen the certainty that both did stake their life, and held it lightly both in their own case and in the case of the other; but that is not for those who underwent this struggle. They cancel their consciousness which had its place in this alien element of natural existence; in other words, they cancel themselves and are sublated as terms or extremes seeking to have existence on their own account. But along with this there vanishes from the play of change the essential moment, viz. that of breaking up into extremes with opposite characteristics; and the middle term collapses into a lifeless unity which is broken up into lifeless extremes, merely existent and not opposed. And the two do not mutually give and receive one another back from each other through consciousness; they let one another go quite indifferently, like things. Their act is abstract negation, not the negation characteristic of consciousness, which cancels in such a way that it preserves and maintains what is sublated, and thereby survives its being sublated.

In this experience self-consciousness becomes aware that *life* is as essential to it as pure self-consciousness. In immediate self-consciousness the simple ego is absolute object, which, however, is for us or in itself absolute mediation, and has as its essential moment substantial and solid independence. The dissolution of that simple unity is the result of the first experience; through this there is posited a pure self-consciousness, and a consciousness which is not purely for itself, but for another, i.e. as an existent consciousness, consciousness in the form and shape of thinghood. Both moments are essential, since, in the first instance, they are unlike and opposed, and their reflexion into unity has not yet come to light, they stand as two opposed forms or modes of consciousness. The one is independent, and its essential nature is to be for itself; the other is dependent, and its essence is life or existence for another. The former is the Master, or Lord, the latter the Bondsman.

The master is the consciousness that exists *for itself;* but no longer merely the general notion of existence for self. Rather, it is a consciousness existing on its own account which is mediated with itself through an other consciousness, i.e. through an other whose very nature implies that it is bound up with an independent being or with thinghood in general. The master brings himself into relation to both these moments, to a thing as such, the object of desire, and to the consciousness whose essential character is thinghood. And since the master, is *(a) qua* notion of self-consciousness, an immediate relation of self-existence, but *(b)* is now moreover at the same time mediation, or a being-for-self which is for itself only through an other—he [the master] stands in relation *(a)* immediately to both *(b)* mediately to each through the other. The master relates himself to the bondsman mediately through independent existence, for that is precisely what keeps the bondsman in thrall; it is his chain, from which he could not in the struggle get away, and for that reason he proved himself to be dependent, to have his independence in the shape of thinghood. The master, however, is the power controlling this state of existence, for he has shown in the struggle that he holds it to be merely something negative. Since he is the power dominating existence, while this existence again is the power controlling the other [the bondsman], the master holds, *par consequence,* this other in subordination. In the same way the master relates himself to the thing mediately through the bondsman. The bondsman being a self-consciousness in the broad sense, also takes up a negative attitude to things and cancels them; but the thing is, at the same time, independent for him, and, in consequence, he cannot, with all his negating, get so far as to annihilate it outright and be done with it; that is to say, he merely works on it. To the master, on the other hand, by menas of this mediating process, belongs the immediate relation, in the sense of the pure negation of it, in other words he gets the enjoyment. What mere desire did not attain, he now succeeds in attaining, viz. to have done with the thing, and find satisfaction in enjoyment. Desire alone did not get the length of this, because of the independence of the thing. The master, however, who has interposed the bondsman between it and himself, thereby relates himself merely to the dependence of the thing, and enjoys it without qualification and without reserve. The aspect of its independence he leaves to the bondsman, who labours upon it.

In these two moments, the master gets his recognition through an other consciousness, for in them the latter affirms itself as unessential, both by working upon the thing, and, on the other hand, by the fact of being dependent on a determinate existence; in neither case can this other get the mastery over existence, and succeed in absolutely negating it. We have thus here this moment of recognition, viz. that the other consciousness cancels itself as self-existent, and, *ipso facto,* itself does what the first does to it. In the same way we have the other moment, that this action on the part of the second is the action proper of the first; for what is done by the bondsman is properly an action on the part of the master. The latter exists only for himself, that is his essential nature; he is the negative power without qualification, a power to which the thing is naught. And he is thus the absolutely essential act in this situation, while the bondsman is not so, he is an unessential activity. But for recognition proper there is needed the moment that what the master does to the other he should also do to himself, and what the bondsman does to himself, he should do to the other also. On that account a form of recognition has arisen that is one sided and unequal.

In all this, the unessential consciousness is, for the master, the object which embodies the truth of his certainty of himself. But it is evident that this object does not correspond to its notion; for, just where the master has effectively achieved lordship, he really finds that something has come about quite different from an independent consciousness. It is not an independent, but rather a dependent consciousness that he has achieved. He is thus not assured of self-existence as his truth; he finds that his truth is rather the unessential consciousness, and the fortuitous unessential action of that consciousness.

The truth of the independent consciousness is accordingly the consciousness of the bondsman. This doubtless appears in the first instance outside itself, and not as the truth of self-consciousness. But just as lordship showed its essential nature to be the reverse of what it wants to be, so, too, bondage will, when completed, pass into the opposite of what it immediately is: being a consciousness repressed within itself, it will enter into itself, and change round into real and true independence.

We have seen what bondage is only in relation to lordship. But it is a self-consciousness, and we have now to consider what it is, in this regard, in and for itself. In the first instance, the master is taken to be the essential reality for the state of bondage; hence, for it, the truth is the independent consciousness existing for itself, although this truth is not taken yet as inherent in bondage itself. Still, it does in fact contain within itself this truth of pure negativity and self-existence, because it has experienced this reality within it. For this consciousness was not in peril and fear for this element or that, nor for this or that moment of time, it was afraid for its entire being; it felt the fear of death, the sovereign master. It has been in that experience melted to its inmost soul, has trembled throughout its every fibre, and all that was fixed and steadfast has quaked within it. This complete perturbation of its entire substance, this absolute dissolution of all its stability into fluent continuity, is, however, the simple, ultimate nature of self-consciousness, absolute negativity, pure self-referrent existence, which consequently is involved in this type of consciousness. This moment of pure self-existence is moreover a fact for it; for in the master it finds this as its object. Further, this bondsman's consciousness is not only this total dissolution in a general way; in serving and toiling the bondsman actually carries this out. By serving he cancels in every particular aspect his dependence on and attachment to natural existence, and by his work removes this existence away.

The feeling of absolute power, however, realized both in general and in the particular form of service, is only dissolution implicitly; and albeit the fear of the lord is the beginning of wisdom, consciousness is not therein aware of being self-existent. Through work and labour, however, this consciousness of the bondsman comes to itself. In the moment which corresponds to desire in the case of the master's consciousness, the aspect of the non-essential relation to the thing seemed to fall to the lot of the servant, since the thing there retained its independence. Desire has reserved to itself the pure negating of the object and thereby unalloyed feeling of self. This satisfaction, however, just for that reason is itself only a state of evanescence, for it lacks objectivity or subsistence. Labour, on the other hand, is desire restrained and checked, evanescence delayed and postponed; in other words, labour shapes and fashions the thing. The negative relation to the object passes into the *form* of the object, into something that is permanent and remains; because it is just for the labourer that the object has independence. This negative mediating agency, this activity giving shape and form, is at the same time the individual existence, the pure self-existence of that consciousness, which now in the work it does is externalized and passes into the condition of permanence. The consciousness that toils and serves accordingly attains by this means the direct apprehension of that independent being as its self.

But again, shaping or forming the object has not only the positive significance that the bondsman becomes thereby aware of himself as factually and objectively self-existent; this type of consciousness has also a negative import, in contrast with its first moment, the element of fear. For in shaping the thing it only becomes aware of its own proper negativity, its existence on its own account, as an object, through the fact that it cancels the actual form confronting it. But this objective negative element is precisely the alien, external reality, before which it trembled. Now, however, it destroys this extraneous alien negative, affirms and sets itself up as a negative in the element of permanence, and thereby becomes for itself a self-existent being. In the master, the bondsman feels self-existence to be something external, an objective fact; in fear self-existence is present within himself; in fashioning the thing, self-existence comes to be felt explicitly as his own proper being, and he attains the consciousness that he himself exists in its own right and on its own account *(an und für sich)*. By the fact that the form is objectified, it does not become something other than the consciousness moulding the thing through work; for just that form is his pure self-existence, which therein becomes truly realized. Thus precisely in labour where there seemed to be merely some outsider's mind and ideas involved, the bondsman becomes aware, through this re-discovery of himself by himself, of having and being a ''mind of his own''.

For this reflexion of self into self the two moments, fear and service in general, as also that of formative activity, are necessary: and at the same time both must exist in a universal manner. Without the discipline of service and obedience, fear remains formal and does not spread over the whole known reality of existence. Without the formative activity shaping the thing, fear remains inward and mute, and consciousness does not become objective for itself. Should consciousness shape and form the thing without the initial state of absolute fear, then it has a merely vain and futile ''mind of its own''; for its form or negativity is not negativity *per se,* and hence its formative activity cannot furnish the consciousness of itself as essentially real. If it has endured not absolute fear, but merely some slight anxiety, the negative reality has remained external to it, its substance has not been through and through infected thereby. Since the entire content of its natural consciousness has not tottered and shaken, it is still inherently a determinate mode of being; having a "mind of its own" *(der eigene Sinn)* is simply stubbornness *(Eigensinn)*, a type of freedom which does not get beyond the attitude of bondage. As little as the pure form can become its essential nature, so little is that form, considered as extending over particulars, a universal formative activity, an absolute notion; it is rather a piece of cleverness which has mastery within a certain range, but not over the universal power nor over the entire objective reality.

NOTE

1. "Sublation" means "the dialectic cancelling of the other"—that is, preserving the positive aspects of what is being cancelled, while doing away with the negative ones [ed. note].

FEMINIST

The dialectic within cultural history

SHULAMITH FIRESTONE

■ Shulamith Firestone *was born in Ottawa, Canada, toward the end of World War II. She grew up in the Midwest and received a degree in Fine Arts from the Art Institute of Chicago. She was a founder of the Women's Liberation Movement and, later, editor of* Notes, *a journal of radical feminism. Her book* The Dialectic of Sex *attracted world-wide attention. The following selection is from that book.*

Firestone's chief claim here is that in the history of culture, there is an underlying dialectic of sex. Culture is seen to have evolved historically along two modes: (1) The Aesthetic Mode of culture rests on imagination, and the active search for an alternate, ideal reality. Art and poetry are associated with this mode. (2) The Technological Mode rests on experimentation and the scientific method. It seeks to master nature rather than to construct an alternative reality. Since the first mode is regarded as subjective and intuitive, it corresponds with "female" behavior. The second mode is regarded as objective and logical, hence corresponding to "male" behavior. "Thus the aesthetic is the cultural recreation of that half of the psychological spectrum that has been appropriated to the female, whereas the technological response is the cultural magnification of the male half."

According to Firestone we are now living in the age of the Technological Mode, and the contradictions within it are threatening to explode. Knowledge has developed to the point that it has assumed a life of its own: "The machine has its own momentum." (Firestone seems here to be arguing for this autonomy of technology.) This situation will culminate soon in a sexual revolution that obliterates the divisions between the two modes and integrates them into one richer mode which will give rise to an androgynous culture. Then "control and delay of 'id' satisfaction by the 'ego' will be unnecessary." Thus the repressive aspect of civilization described by both Freud and Marcuse (see earlier selections) is seen by Firestone as disappearing in this new culture.

So far we have treated "culture" as synonymous with "arts and letters" or at its broadest, "humanities." This is a common enough confusion. But it is startling in this context. For we discover that, while only indirectly related to art, women have been entirely excluded from an equally important half of culture: science. If at least with the arts we could find enough material about the relationship of women to culture—whether indirectly as influence, stimulus, or subject matter, or even occasionally as direct participants—to fill at least a chapter, we can hardly find a relationship of women to science worthy of discussion. Perhaps in the broadest sense our statement that women are the emotional force behind all (male) culture holds true—but we are stretching the case to include modern science, where the empirical method specifically demands the exclusion of the scientist's personality from his research. Satisfaction of his emotional needs through a woman in his off hours may make him more stable, and thus steadier on the job, but this is farfetched.

But if even the indirect relationship of women to science is debatable, that there is no direct one is certainly not. One would have to search to find even one woman who had contributed in a major way to scientific culture. Moreover, the situation of women in science is not improving. Even with the work of discovery shifted from the great comprehensive minds of the past to small pragmatic university research teams, there are remarkably few women scientists.[1]

This absence of women at all levels of the scientific disciplines is so commonplace as to lead many (otherwise intelligent) people to attribute it to some deficiency (logic?) in women themselves. Or to women's own predilections for the emotional and subjective over the practical and rational. But the question cannot be so easily dismissed. It is true that women in science are in foreign territory—but how has this situation evolved? Why are there disciplines or branches of inquiry that demand only a "male" mind? Why would a woman, to qualify, have to develop an alien psychology? When and why was the female excluded from this type mind? How and why has science come to be defined as, and restricted to, the "objective"?

I submit that not only were the arts and humanities corrupted by the sex duality, but that modern science has been determined by it. And moreover that *culture reflects this polarity in its*

☐ From *The Dialectic of Sex*, by Shulamith Firestone, pp. 170-191.

very organization. C. P. Snow was the first to note what had been becoming increasingly obvious: a deep fissure of culture—the liberal arts and the sciences had become incomprehensible to each other. Again, though the universal man of the Renaissance is widely lamented, specialization only increases. These are some of the modern symptoms of a long cultural disease based on the sex dualism. Let us examine the history of culture according to this hypothesis—that there is an underlying dialectic of sex.

I. THE TWO MODES OF CULTURAL HISTORY

For our analysis we shall define culture in the following way: *Culture is the attempt by man to realize the conceivable in the possible*. Man's consciousness of himself within his environment distinguishes him from the lower animals, and turns him into the only animal capable of culture. This consciousness, his highest faculty, allows him to project mentally states of being that do not exist at the moment. Able to construct a past and future, he becomes a creature of time—a historian and a prophet. More than this, he can imagine objects and states of being that have never existed and may never exist in the real world—he becomes a maker of art. Thus, for example, though the ancient Greeks did not know how to fly, still they could imagine it. The myth of Icarus was the formulation in fantasy of their conception of the state "flying."

But man was not only able to project the conceivable into fantasy. He also learned to impose it on reality: by accumulating knowledge, learning experience, about that reality and how to handle it, he could shape it to his liking. This accumulation of skills for controlling the environment, technology, is another means to reaching the same end, the realization of the conceivable in the possible. Thus, in our example, if, in the B.C. era, man could fly on the magic carpet of myth or fantasy, by the twentieth century, his technology, the accumulation of his practical skills, had made it possible for him to fly in actuality—he had invented the airplane. Another example: In the Biblical legend, the Jews, an agricultural people stranded for forty years in the desert, were provided by God with Manna, a miraculous substance that could be transformed at will into food of any color, texture, or taste; modern food processing, especially with the "green revolution," will probably soon create a totally artificial food production, perhaps with this chameleon attribute. Again, in ancient legend, man could imagine mixed species, e.g., the centaur or the unicorn, or hybrid births, like the birth on an animal from a human, or a virgin birth; the current biological revolution, with its increasing knowledge of the reproductive process, could now—if only the first crude stages—create these "monstrosities" in reality. Brownies and elves, the Golem of medieval Jewish lore, Mary Shelley's monster in *Frankenstein,* were the imaginative constructions that preceded by several centuries the corresponding technological acumen. Many other fantastical constructions—ghosts, mental telepathy, Methuselah's age—remain to be realized by modern science.

These two different responses, the idealistic and the scientific, do not merely exist simultaneously: there is a dialogue between the two. The imaginative construction precedes the technological, though often it does not develop until the technological know-how is "in the air." For example, the art of science fiction developed, in the main, only a half-century in advance of, and now coexists with, the scientific revolution that is transforming it into a reality—for example (an innocuous one), the moon flight. The phrases "way out," "far out," "spaced," the observation "it's like something out of science fiction" are common language. In the aesthetic response, because it always develops in advance, and is thus the product of another age, the same realization may take on a sensational or unrealistic cast, e.g., Frankenstein's monster, as opposed to, let us say, General Electric's CAM (Cybernetic Anthropomorphic Machines) Handyman. (An artist can never know in advance just how his vision might be articulated in reality.)

Culture then is the sum of, and the dynamic between, the two modes through which the mind attempts to transcend the limitations and contingencies of reality. These two types of cultural responses entail different methods to achieve the same end, the realization of the conceivable in the possible. In the first,[2] the individual denies the limitations of the given reality by escaping from it altogether, to define, create, his own possible. In the provinces of the imagination, objectified in some way—whether through the development of a visual image within some artificial boundary, say four square feet of canvas, through visual images projected through verbal symbols (poetry), with sound ordered into a sequence (music), or with verbal ideas ordered into a progression (theology, philosophy)—he creates an ideal world governed by his own artificially imposed order and harmony, a structure in which he consciously relates each part to the whole, a static (and therefore ''timeless'') construction. The degree to which he abstracts his creation from reality is unimportant, for even when he most appears to imitate, he has created an illusion governed by its own—perhaps hidden—set of artificial laws. (Degas said that the artist had to lie in order to tell the truth.) This search for the ideal, realized by means of an artificial medium, we shall call the Aesthetic Mode.

In the second type of cultural response the contingencies of reality are overcome, not through the creation of an alternate reality, but through the mastery of reality's own workings: the laws of nature are exposed, then turned against it, to shape it in accordance with man's conception. If there is a poison, man assumes there is an antidote; if there is a disease, he searches for the cure: every fact of nature that is understood can be used to alter it. But to achieve the ideal through such a procedure takes much longer, and is infinitely more painful, especially in the early stages of knowledge. For the vast and intricate machine of nature must be entirely understood—and there are always fresh and unexpected layers of complexity—before it can be thoroughly controlled. Thus before any solution can be found to the deepest contingencies of the human condition, e.g., death, natural processes of growth and decay must be catalogued, smaller laws related to larger ones. This scientific method (also attempted by Marx and Engels in their materialistic approach to history) is the attempt by man to master nature through the complete understanding of its mechanics. The coaxing of reality to conform with man's conceptual ideal, through the application of information extrapolated from itself, we shall call the Technological Mode.

We have defined culture as the sum of, and the dialectic between, the two different modes through which man can resolve the tension created by the flexibility of his mental faculties within the limitations of his given environment. The correspondence of these two different cultural modes with the two sexes respectively is unmistakable. We have noted how those few women directly creating culture have gravitated to disciplines within the Aesthetic Mode. There is good reason for this: the aesthetic response corresponds with ''female'' behavior. The same terminology can be applied to either: subjective, intuitive, introverted, wishful, dreamy or fantastic, concerned with the subconscious (the *id*), emotional, even temperamental (hysterical). Correspondingly, the technological response is the masculine response: objective, logical, extroverted, realistic, concerned with the conscious mind (the ego), rational, mechanical, pragmatic and down-to-earth, stable. Thus the aesthetic is the cultural recreation of that half of the psychological specturm that has been appropriated to the female, whereas the technological response is the cultural magnification of the male half.

Just as we have assumed the biological division of the sexes for procreation to be the fundamental ''natural'' duality from which grows all further division into classes, so we now assume the sex division to be the root of this basic cultural division as well. The interplay between these two cultural responses, the ''male'' Technological Mode and the ''female'' Aesthetic Mode, recreates at yet another level the dialectic of the sexes—as well as its superstructure, the caste and the economic-class dialectic. And just as the merging of the divided sexual, racial, and economic classes is a precondition for sexual, racial, or economic revolution respectively, so the merging of the aesthetic with the technological culture is the precondition of a cultural revolution. And just as the revolutionary goal of the sexual, racial, and economic revolutions is, rather than a mere leveling of imbalances of class, an elimination of class categories altogether, so the end result of a cultural revolution must be, not merely the integration of the two streams of culture, but the elimination of cultural categories altogether, the elimination of culture itself as we know it. But before we discuss this ultimate cultural revolution or even the state of cultural division in our own time, let us see how this third level of the sex dialectic—the interaction between the Technological and Aesthetic Modes—operated to determine the flow of cultural history.

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At first technological knowledge accumulated slowly. Gradually man learned to control the crudest aspects of his environment—he discovered the tool, control of fire, the wheel, the melting of ore to make weapons and plows, even, eventually, the alphabet—but these discoveries were few and far between, because as yet he had no systematic way of initiating them. Eventually however, he had gathered enough practical knowledge to build whole systems, e.g., medicine or architecture, to create juridical, political, social, and economic institutions. Civilization developed from the primitive hunting horde into an agricultural society, and finally, through progressive stages, into feudalism, capitalism, and the first attempts at socialism.

But in all this time, man's ability to picture an ideal world was far ahead of his ability to create one. The primary cultural forms of ancient civilizations—religion and its offshoots, mythology, legend, primitive art and magic, prophesy and history—were in the Aesthetic Mode: they imposed only an artificial, imaginary order on a universe still mysterious and chaotic. Even primitive scientific theories were only poetic metaphors for what would later be realized empirically. The science and philosophy and mathematics of classical antiquity, forerunners of modern science, by sheer imaginative prowess, operating in a vacuum independently of material laws, anticipated much of what was later proven: Democritus' atoms and Lucretius' "substance" foreshadowed by thousands of years the discoveries of modern science. But they were realized only within the realm of the imaginary Aesthetic Mode.

In the Middle Ages the Judaeo-Christian heritage was assimilated with pagan culture, to produce medieval religious art and the metaphysics of Thomas Aquinas and the Scholastics. Though concurrently Arab science, an outgrowth of the Greek Alexandrian Period (third century B.C. to seventh century A.D.), was amassing considerable information in such areas as geography, astronomy, physiology, mathematics—a tabulation essential to the later empiricism—there was little dialogue. Western science, with its alchemy, its astrology, the "humours" of medieval medicine, was still in a "pseudo-scientific" stage, or, in our definition, still operating according to the Aesthetic Mode. This medieval aesthetic culture, composed of the Classical and Christian legacies, culminated in the Humanism of the Renaissance.

Until the Renaissance, then, culture occurred in the Aesthetic Mode because, prior to that time, Technology had been so primitive, the body of scientific knowledge so far from complete. In terms of the sex dislectic, this long stage of cultural history corresponds with the matriarchal stage of civilization: The Female Principle—dark, mysterious, uncontrollable—reigned, elevated by man himself, still in awe of unfathomable Nature. Men of culture were its high priests of homage: until and through the Renaissance *all* men of culture were practitioners of the ideal aesthetic mode, thus, in a sense, artists. The Renaissance, the pinnacle of cultural humanism, was the golden age of the Aesthetic (female) Mode.

And also the beginning of its end. By the sixteenth century culture was undergoing a change as profound as the shift from matriarchy to patriarchy in terms of the sex dialectic, and corresponding to the decline of feudalism in the class dialectic. This was the first merging of the aesthetic culture with the technological, in the creation of modern (empirical) science.

In the Renaissance, Aristotelian Scholasticism had remained powerful though the first cracks in the dam were already apparent. But it was not until Francis Bacon, who first proposed to use science to "extend more widely the limits of the power and the greatnesses of man," that the marriage of the Modes was consummated. Bacon and Locke transformed philosophy, the attempt to understand life, from abstract speculation detached from the real world (metaphysics, ethics, theology, aesthetics, logic) to an uncovering of the *real* laws of nature, through proof and demonstration (empirical science).

In the empirical method propounded by Francis Bacon, insight and imagination had to be used only at the earliest stage of the inquiry. Tentative hypotheses would be formed by induction from the facts, and then consequences would be deduced logically and tested for consistency among themselves and for agreement with the primary facts and results of *ad hoc* experiments. The hypothesis would become an accepted theory only after all tests had been passed, and would remain, at least until proven wrong, a theory capable of predicting phenomena to a high degree of probability.

The empirical view held that by recording and tabulating all possible observations and experiments in this manner, the Natural Order would emerge automatically. Though at first the question "why" was still asked as often as the question "how," after information began to accumulate, each discovery building upon the last to complete the jigsaw, the speculative, the intuitive, and the imaginative gradually became less valuable. When once the initial foundations had been laid by men of the stature of Kepler, Galileo, and Newton, thinkers still in the inspired "aesthetic" science tradition, hundreds of anonymous technicians could move to fill in the blanks, leading to, in our own time, the dawn of a golden age of science—to the Technological Mode what the Renaissance had been to the Aesthetic Mode.

II. THE TWO CULTURES TODAY

Now, in 1970, we are experiencing a major scientific breakthrough. The new physics, relativity, and the astrophysical theories of contemporary science had already been realized by the first part of this century. Now, in the latter part, we are arriving, with the help of the electron microscope and other new tools, at similar achievements in biology, biochemistry, and all the life sciences. Important discoveries are made yearly by small, scattered work teams all over the United States, and in other countries as well—of the magnitude of DNA in genetics, or of Urey and Miller's work in the early fifties on the origins of life. Full mastery of the reproductive process is in sight, and there has been significant advance in understanding the basic life and death process. The nature of aging and growth, sleep and hibertion, the chemical functioning of the brain and the development of consciousness and memory are all beginning to be understood in their entirety. This acceleration promises to continue for perhaps another century, however long it takes to achieve the goal of Empiricism: total understanding of the laws of nature.

This amazing accumulation of concrete knowledge in only a few hundred years is the product of philosophy's switch from the Aesthetic to the Technological Mode. The combination of "pure" science, science in the Aesthetic Mode, with pure technology, caused greater progress toward the goal of technology—the realization of the conceivable in the actual—than had been made in thousands of years of previous history.

Empiricism itself is only the means, a quicker and more effective technique, for achieving technology's ultimate cultural goal: the building of the ideal in the real world. One of its own basic dictates is that a certain amount of material must be collected and arranged into categories before any decisive comparison, analysis, or discovery can be made. In this light, the centuries of empirical science have been little more than the building of foundations for the breakthroughs of our own time and the future. The amassing of information and understanding of the laws and mechanical processes of nature ("pure research") is but a means to a larger end: total understanding of Nature in order, ultimately, to transcend it.

In this view of the development and goals of cultural history, Engels' final goal, quoted above in the context of political revolution, is again worthy of quotation:

> The whole sphere of the condition of life which environ man, and have hitherto ruled him, now comes under the dominion and control of man, who for the first time becomes the real conscious Lord of Nature.

Empirical science is to culture what the shift to patriarchy was to the sex dialectic, and what the bourgeois period is to the Marxian dialectic—a latter-day stage prior to revolution. Moreover, the three dialectics are integrally related to one another vertically as well as horizontally: The empirical science growing out of the bourgeoisie (the bourgeois period is in itself a stage of the patriarchal period) follows the humanism of the aristocracy (The Female Principle, the matriarchy) and with its development of the empirical method in order to amass real knowledge (development of modern industry in order to amass capital) eventually puts itself out of business. The body of scientific discovery (the new productive modes) must finally outgrow the empirical (capitalistic) mode of using them.

And just as the internal contradictions of capitalism must become increasingly apparent, so must the internal contradictions of empirical science—as in the development of pure knowledge to the point where it assumes a life of its own, e.g., the atomic bomb. As long as man is still engaged only in the means—the charting of the ways of nature, the gathering of "pure" knowledge—to his final realization, mastery of nature, his knowledge, because it is not complete, is dangerous. So dangerous that many scientists are wondering whether they shouldn't put a lid on certain types of research. But this solution is hopelessly inadequate. The machine of empiricism has its own momentum, and is, for such purposes, completely out of control. Could one actually decide what to discover or not discover? That is, by definition, antithetical to the whole empirical process that Bacon set in motion. Many of the most important discoveries have been practically laboratory accidents, with social implications barely realized by the scientists who stumble into them. For example, as recently as five years ago Professor F. C. Steward of Cornell discovered a process called ''cloning'': by placing a single carrot cell in a rotating nutrient he was able to grow a whole sheet of identical carrot cells, from which he eventually re-created the same carrot. The understanding of a similar process for more developed animal cells, were it to slip out—as did experiments with ''mind-expanding'' drugs—could have some awesome implications. Or, again, imagine parthenogenesis, virgin birth, as practiced by the greenfly, actually applied to human fertility.

Another internal contradiction in empirical science: the mechanistic, deterministic, ''soulless'' scientific world-view, which is the result of the means to, rather than the (inherently noble and often forgotten) ultimate purpose of, Empiricism: the actualization of the ideal in reality.

The cost in humanity is particularly high to the scientist himself, who becomes little more than a cultural technician. For, ironically enough, to properly accumulate knowledge of the universe requires a mentality the very opposite of comprehensive and integrated. Though in the long run the efforts of the individual scientist could lead to domination of the environment in the interest of humanity, temporarily the empirical method demands that its practitioners themselves become ''objective,'' mechanistic, overprecise. The public image of the white-coated Dr. Jekyll with no feelings for his subjects, mere guinea pigs, is not entirely false: there is no room for feelings in the scientist's work; he is forced to eliminate or isolate them in what amounts to an occupational hazard. At best he can resolve this problem by separating his professional from his personal self, by compartmentalizing his emotion. Thus, though often well-versed in an academic way about the arts—the frequency of this, at any rate, is higher than of artists who are well-versed in science—the scientist is generally out of touch with his direct emotions and senses, or, at best, he is emotionally divided. His ''private'' and ''public'' life are out of whack; and because his personality is not well-integrated, he can be surprisingly conventional (''Dear, I discovered how to clone people at the lab today. Now we can go skiing at Aspen.'') He feels no contradiction in living by convention, even in attending church, for he has never integrated the amazing material of modern science with his daily life. Often it takes the misuse of his discovery to alert him to that connection which he has long since lost in his own mind.

The catalogue of scientific vices is familiar: it duplicates, exaggerates, the catalogue of ''male'' vices in general. This is to be expected: if the Technological Mode develops from the male principle then it follows that its practitioners would develoop the warpings of the male personality in the extreme. But let us leave science for the moment, winding up for the ultimate cultural revolution, to see what meanwhile had been happening to the aesthetic culture proper.

With philosophy in the broadest classical sense—including ''pure'' science—defecting, aesthetic culture became increasingly narrow and ingrown, reduced to the arts and humanities in the refined sense that we now know them. Art (hereafter referring to the ''liberal arts,'' especially the arts and letters) had always been, in its very definition, a search for the ideal, removed from the real world. But in primitive days it had been the handmaiden of religion, articulating the common dream, objectifying ''other'' worlds of the common fantasy, e.g., the art of the Egyptian tombs, to explain and excuse this one. Thus even though it was removed from the real world, it served an important social function: it satisfied artifically those wishes of society that couldn't yet be realized in reality. Though it was patronized and supported only by the aristocracy, the cultured elite, it was never as detached from life as it later became; for the society of those times was, for all practical purposes,synonymous with its ruling class, whether priesthood, monarchy, or nobility. The masses were never considered by ''society'' to be a legitimate part of humanity, they were slaves, nothing more than human animals, drones, or serfs, without whose labor the small cultured elite could not have maintained itself.

The gradual squeezing out of the aristocracy by the new middle class, the bourgeoisie, signalled the erosion of aesthetic culture. We have seen that capitalism intensified the worst attributes of patriarchalism, how, for example, the nuclear family emerged from the large, loose family household of the past, to reinforce the weakening sex class system, oppressing women and children more intimately than ever before. The cultural mode favored by this new, heavily patriarchal bourgeoisie was the "male" Technological Mode—objective, realistic, factual, "commonsense"—rather than the effeminate, otherworldly, "romantic idealist" Aesthetic Mode. The bourgeoisie, searching for the ideal in the real, soon developed the empirical science that we have described. To the extent that they had any remaining use for aesthetic culture, it was only for "realistic" art, as opposed to the "idealistic" art of classical antiquity, or the abstract religious art of primitive or medieval times. For a time they went in for a literature that described reality—best exemplified by the nineteenth-century novel—and a decorative easel art: still lifes, portraits, family scenes, interiors. Public museums and libraries were built alongside the old salons and private galleries. But with its entrenchment as a secure, even primary, class, the bourgeoisie no longer needed to imitate aristocratic cultivation. More important, with the rapid development of their new science and technology, the little practical value they had for art was eclipsed. Take the scientific development of the camera: The bourgeoisie soon had little need for portrait painters; the little that painters or novelists had been able to do for them, the camera could do better.

"Modern" art was a desperate, but finally self-defeating, retaliation *("épater le bourgeois")* for these injuries: the evaporation of its social function, the severance of the social umbilical cord, the dwindling of the old sources of patronage. The modern art tradition, associated primarily with Picasso and Cézanne, and including all the major schools of the twentieth century—cubism, constructivism, futurism, expressionism, surrealism, abstract expressionism, and so on—is not an authentic expression of modernity as much as it is a reaction to the realism of the bourgeoisie. Post-impressionism deliberately renounced all reality-affirming conventions—indeed the process began with impressionism itself, which broke down the illusion into its formal values, swallowing reality whole and spitting it up again as art—to lead eventually to an art-for-art's-sake so pure, a negation of reality so complete as to make it ultimately meaningless, sterile, even absurd. (Cab drivers *are* philistine: they know a put-on when they see one.) The deliberate violating, deforming, fracturing of the image, called "modern" art, was nothing more than a fifty-year idol smashing—eventually leading to our present cultural impasse.

In the twentieth century, its life blood drained, its social function nullified altogether, art is thrown back on whatever wealthy classes remain, those *nouveaux riches*—particularly in America, still suffering from a cultural inferiority complex—who still need to prove they have "arrived" by evidencing a taste for culture. The sequestering of intellectuals in ivory tower universities, where, except for the sciences, they have little effect on the outside world, no matter how brilliant (and they aren't, because they no longer have the necessary feedback); the abstruse—often literally unintelligible—jargon of the social sciences; the cliquish literary quarterlies with their esoteric poetry; the posh 57th Street galleries and museums (it is no accident that they are right next door to Saks Fifth Avenue and Bonwit Teller) staffed and supplied by, for the most part, fawning rich-widows'-hairdresser types; and not least the vulturous critical establishment thriving on the remains of what was once a great and vital culture—all testify to the death of aesthetic humanism.

For the centuries that Science climbed to new heights, Art decayed. Its forced inbreeding transformed it into a secret code. By definition escapist from reality, it now turned in upon itself to such degree that it gnawed away its own vitals. It became diseased—neurotically self-pitying, self-conscious, focused on the past (as opposed to the futurist orientation of the technological culture) and thus frozen into conventions and academies—orthodoxies of which "avant-garde" is only the latest—pining for remembered glories, the Grand Old Days When Beauty Was In Flower; it became pessimistic and nihilistic, increasingly hostile to the society at large, the "philistines." And when the cocky young Science attempted to woo Art from its ivory tower—eventually garret—with false promises of the courting lover ("You can come down now, we're making the world a better place every day"), Art refused more vehemently than ever to deal with him, much less accept his corrupt gifts, retreating ever deeper into her daydreams—neoclassicism, romanticism, expressionism, surrealism, existentialism.

The individual artist or intellectual saw himself as either a member of an invisible elite, a "highbrow," or as a down-and-outer, mingling with whoever was deemed the dregs of his society. In both cases, whether playing Aristocrat or Bohemian, he was on the margins of the society as a whole. The artist had become a freak. His increasing alienation from the world around him—the new world that science had created was, especially in its primitive stages, an incredible horror, only intensifying his need to escape to the ideal world of art—his lack of an audience, led to a mystique of "genius." Like an ascetic Saint Simeon on his pedestal, the Genius in the Garret was expected to create masterpieces in a vacuum. But his artery to the outside world had been severed. His task, increasingly impossible, often forced him into literal madness, or suicide.

Painted into a corner with nowhere else to go, the artist has got to begin to come to terms with the modern world. He is not too good at it: like an invalid shut away too long, he dosen't know anything about the world anymore, neither politics, nor science, nor even how to live or love. Until now, yes, even now, though less and less so, sublimation, that warping of personality, was commendable: it was the only (albeit indirect) way to achieve fulfillment. But the artistic process has—almost—outlived its usefulness. And its price is high.

The first attempts to confront the modern world have been for the most part misguided. The Bauhaus, a famous example, failed at its objective of replacing an irrelevant easel art (only a few optical illusions and designy chairs mark the grave), ending up with a hybrid, neither art nor science, and certainly not the sum of the two. They failed because they didn't understand science on its own terms: to them, seeing in the old aesthetic way, it was simply a rich new subject matter to be digested whole into the traditional aesthetic system. It is as if one were to see a computer as only a beautifully ordered set of lights and sounds, missing completely the function itself. The scientific experiment is not only beautiful, an elegant structure, another piece of an abstract puzzle, something to be used in the next collage—but scientists, too, in their own way, see science as this abstraction divorced from life—it has a real intrinsic meaning of its own, similar to, but not the same as, the "presence," the "*en-soi,*" of modern painting. Many artists have made the mistake of thus trying to annex science, to incorporate it into their own artistic framework, rather than using it to expand that framework.

Is the current state of aesthetic culture all bleak? No, there have been some progressive developments in contemporary art. We have mentioned how the realistic tradition in painting died with the camera. This tradition had developed over centuries to a level of illusionism with the brush—examine a Bouguereau—that was the equal of, better than, the early photography, then considered only another graphic medium, like etching. The beginning of the new art of film and the realistic tradition of painting overlapped, peaked, in artists like Degas, who used a camera in his work. Then realistic art took a new course: Either it became decadent, academic, divorced from any market and meaning, e.g., the nudes that linger on in art classes and second-rate galleries, or it was fractured into the expressionist or surrealist image, posing an alternate internal or fantastical reality. Meanwhile, however, the young art of film, based on a true synthesis of the Aesthetic and Technological Modes (as Empiricism itself had been), carried on the vital realistic tradition. And just as with the marriage of the divided male and female principles, empirical science bore fruit; so did the medium of film. But, unlike other aesthetic media of the past, it broke down the very division between the artificial and the real, between culture and life itself, on which the Aesthetic Mode is based.

Other related developments: the exploration of artificial materials, e.g., plastics; the attempt to confront plastic culture itself (pop art); the breakdown of traditional categories of media (mixed media), and of the distinctions between art and reality itself (happenings, environments). But I find it difficult to unreservedly call these latter developments progressive: as yet they have produced largely puerile and meaningless works. The artist does not yet know what reality is, let alone how to affect it. Paper cups lined up on the street, pieces of paper thrown into an empty lot, no matter how many ponderous reviews they get in *Art News,* are a waste of time. If these clumsy attempts are at all hopeful, it is only insofar as they are signs of the breakdown of "fine" art.

The merging of the Aesthetic with the Technological Mode will gradually suffocate "pure" high art altogether. The first breakdown of categories, the remerging of art with a (technologized) reality, indicate that we are now in the transitional pre-revolutionary period, in which the three separate cultural streams, technology ("applied science"), "pure research," and "pure" modern art, will melt together—along with the rigid sex categories they reflect.

The sex-based polarity of culture still causes many casualities. If even the "pure" scientist, e.g., nuclear physicist (let alone the "applied" scientist, e.g., engineer), suffers from too much "male," becoming authoritarian, conventional, emotionally insensitive, narrowly unable to understand his own work within the scientific—let alone cultural or social—jigsaw, the artist, in terms of the sex division, has embodied all the imbalances and suffering of the female personality: temperamental, insecure, paranoid, defeatist, narrow. And the recent withholding of reinforcements from behind the front (the larger society) has exaggerated all this enormously; his overdeveloped "id" has nothing left to balance it. Where the pure scientist is "schiz," or worse, *ignorant* of emotional reality altogether, the pure artist *rejects* reality because of its lack of perfection, and, in modern centuries, for its ugliness.[3]

And who suffers the most, the blind (scientist) or the lame (artist)? Culturally, we have had only the choice between one sex role or the other: either a social marginality leading to self-consciousness, introversion, defeatism, pessimism, oversensitivity, and lack of touch with reality, or a split "professionalized" personality, emotional ignorance, the narrow views of the specialist.

CONCLUSION: THE CULTURE-ANTICULTURE REVOLUTION

I have tried to show how the history of culture mirrors the sex dichotomy in its very organization and development. Culture develops not only out of the underlying economic dialectic, but also out of the deeper sex dialectic. Thus, there is not only a horizontal dynamic, but a vertical one as well: each of these three strata forms one more story of the dialectics of history based on the biological dualism. At present we have reached the final stages of Patriarchalism, Capitalism (corporate capitalism), and of the Two Cultures at once. We shall soon have a triplicate set of preconditions for revolution, the absence of which is responsible for the failure of revolutions of the past.

The difference between what is almost possible and what exists is generating revolutionary forces.[4] We are nearing—I believe we shall have, perhaps within a century, if the snowball of empirical knowledge doesn't smash first of its own velocity—a cultural revolution, as well as a sexual and economic one. The cultural revolution, like the economic revolution, must be predicated on the elimination of the (sex) dualism at the origins not only of class, but also of cultural division.

What might this cultural revolution look like? Unlike "cultural revolutions" of the past, it would not be merely a quantitative escalation, more and better culture, in the sense that the Renaissance was a high point of the Aesthetic Mode, or that the present technological breakthrough is the accumulation of centuries of practical knowledge about the real world. Great as they were, neither the Aesthetic nor the Technological culture, even at their respective peaks, ever achieved universality—either it was wholistic but divorced from the real world, or it "achieved progress," at the price of cultural-schizophrenia, and the falseness and dryness of "objectivity." What we shall have in the next cultural revolution is the reintegration of the Male (Technological Mode) with the Female (Aesthetic Mode), to create an androgynous culture surpassing the highs of either cultural stream, or even of the sum of their integrations. More than a marriage, rather an abolition of the cultural categories themselves, a mutual cancellation—a matter-antimatter explosion, ending with a poof! culture itself.

We shall not miss it. We shall no longer need it: by then humanity will have mastered nature totally, will have realized in *actuality* its dreams. With the full achievement of the conceivable in the actual, the surrogate of culture will no longer be necessary. The sublimation process, a detour to wish fulfillment, will give way to direct satisfaction in experience, as felt now only by children, or adults on drugs. (Though normal adults "play" to varying degrees, the example that illustrates more immediately to almost everyone the intense level of this future experience, ranking zero on a scale of accomplishment—"nothing to show for it"—but nevertheless somehow always worth everyone's while, is lovemaking.) Control and delay of "id" satisfaction by the "ego" will be unnecessary; the *id* can live free. Enjoyment will spring directly from being and acting itself, the process of experience, rather than from the quality of achievement. When the male Technological Mode can at least produce in actuality what the female Aesthetic Mode had envisioned, we shall have eliminated the need for either.

NOTES

1. I was struck by this at a recent Women's Liberation workshop scheduled by the science department of a top-level eastern university: of the fifty women present, only one or two were engaged in research, let alone high-level research. The others were lab technicians, graduate assistants, high school science teachers, faculty wives, and the like.
2. The idealistic mode, corresponding roughly to the supra-historical, nonmaterialist "metaphysical" mode of thought against which Marx and Engels revolted.
3. One abstract painter I knew, who had experienced the horrors of North African battlefields in World War II—fields of men (buddies) rotting in the sun with rats darting out of their stomachs—spent years moving a pure beige circle around a pure beige square. In this manner, the "modern" artist denies the ugliness of reality (rats in the stomachs of buddies) in favor of artificial harmonies (circles in squares).
4. Revolutionaries, by definition, are still visionaries of the Aesthetic Mode, the idealists of pragmatic politics.

THIRD WORLD

Technology versus civilization

DENIS GOULET

■ Denis Goulet *was born in 1931 in Fall River, Massachusetts. A noted author, he pioneered a new discipline —the ethics of development. Goulet has lived and worked in Africa, the Middle East, Europe, and Latin America. He holds degrees in philosophy, social planning, and political science. Currently, he is a senior fellow at the Overseas Development Council in Washington, D.C. Among his books are* A New Moral Order: Development Ethics and Liberation Theology *(1974) and* The Crucial Choice: A New Concept in the Theory of Development *(1971).*

In The Uncertain Promise *(1977), Goulet evaluates the problems and promises of the transfer of technology to the Third World. He also discusses questions of policy involved in such transfers. The selection included here contains a critique of Western technology, which "now threatens to annihilate the human species, to destroy the planet's capacity to support life, and to eliminate human meanings in life." And yet, he notes, it is often argued that the world cannot escape a global culture based on Western technology. Quoting John White, Goulet scoffs at this argument as "the last and brillant effort of the white northern world to maintain its cultural dominance in perpetuity, against history, by the pretence that there is no alternative."*

But there is an alternative. It is to allow the "underdeveloped" nations to use their own wisdom in developing fresh outlooks on the relation of technology to society and to help bring forth a new, non-elitist, world order. Thus "the very inability of some poor nations to achieve 'development' may prove a blessing in disguise." Nevertheless, Goulet is not an anti-technologist. His critique is designed to point out the dangers of western technology before it is too late. What he hopes for is a world technology with a human, nonimperialist, face.

Normative consensus over how to deal with change is a vital element in every culture. The term *culture*, as here employed, embraces the way of life of all human groups. It includes all the standardized learning and forms of behavior which others in one's group learn to recognize and expect: language and symbols; multiple forms of organization (family, kin, occupational roles, legitimacy and authority structures, etcetera); heritage (religious, esthetic, ethical, natural). A civilization, in turn, is simply one species in the genus culture, namely,

that kind of culture which includes the use of writing the presence of cities and of wide political organization and the development of occupational specialization.[1]

Central to the notion of all cultures are collective identity, boundaries of inclusion or exclusion of individuals (whether based on criteria of space, lineage, or blood), continuity, and a common historical experience. To all these traits must be added a shared sense of responsibility for the maintenance, dignity, and freedom of the group. Technology poses a unique challenge to culture because its own value dynamics run counter to the limits posed by cultural identity, by spatial or territorial loyalties, or by consensual norms of

☐ From *The Uncertain Promise* (New York: IDOC/North America, 1977), pp. 243-251.

thought and symbolization. The progressive unification of the globe has occurred within a Western framework, but Toynbee believes that "the present Western ascendency in the world is certain not to last."[2] British economist John White explains why:

By all historical parallels, development in the so-called Third World ought to take the form of the rise of new and competing cultures to contend with the old and dying civilization which is co-terminous with the white western world stretching from California to the Urals. The obvious candidates are in Asia, especially in East Asia, where two societies have succeeded in modernizing on the basis of models of social organization which are historically specific and owe little to the international development industry. Yet two new factors cast doubt on the relevance of the Toynbee-esque model of the challenge and response of competing cultures:

(1) technology;

(2) telecommunications.

These factors open the anti-developmental and rather depressing possibility of a single and unchallengeable global culture. Can there ever again be a new civilization?

The assumption that development is a generalisable concept must be seen in this context. It is far more potent than the crude instruments of 'neo-colonialism.' It is the last and brilliant effort of the white northern world to maintain its cultural dominance in perpetuity, against history, by the pretence that there is no alternative.[3]

Is there truly no alternative to standardized technology? Is advanced industrial society incorrigibly one-dimensional? Notwithstanding its enchantment with modern technology, will the Third World be lured by technology into betraying its deeper values as fully as has the West its own? The very impact of Western technology on other civilizations has helped non-Western peoples re-educate themselves. Out of the clash of values has come the clear lesson that no single nation or people can forever be the center of the universe. And though the West has spread the virus of acquisitiveness and the idolatry of material success everywhere, almost nowhere has the West won the hearts of other peoples. Even those who grasp after the West's tools or material rewards do not hold the West's culture in high esteem. A historical parallel is worth citing here. When Napoleon conquered Egypt, the Muslim historian Al-Gabarti displayed no interest in the Frenchman's technology or material wares.

Al-Gabarti showed a nicer discrimination. French technology hit him in the eye, but he persisted in waiting for a sign. For him, the touchstone of Western civilization, as of his own, was not technology but justice. This Cairene scholar has apprehended the heart of the matter, the issue which the West has still to fight out within itself.[4]

Toynbee views Western technology as a kind of scaffolding around which all societies are building themselves into a unified world. Yet this Western-built scaffolding is not itself durable:

The most obvious ingredient in it is technology, and man cannot live by technology alone. In the fullness of time, when the ecumenical house of many mansions stands firmly on its own foundations and the temporary Western scaffolding falls away—as I have no doubt that it will—I believe it will become manifest that the foundations are firm at last because they have been carried down to the bedrock of religion.[5]

The Al-Gabartis of today's Third World no longer seek a sign of justice before adopting the "developed" world's technology; they are wise enough to know that this particular sign will not appear. Nevertheless, they intuitively understand that technology can outlive the "civilization" that diffuses it. Frequently, their vision is more lucid than that of Westerners whose complacency over their technological triumphs blinds them both to the injustices they commit in spreading the *imperium* of technology and to the value impasses the West has created for itself.[6]

Technology now threatens to annihilate the human species, to destroy the planet's capacity to support life, and to eliminate human meanings in life. Small wonder, then, that Innuits (Eskimos)—prototypes of a pretechnological people living at a rudimentary cultural level—deem themselves superior to technologically advanced counterparts. Given the sketchiest training, Innuits master tractors and bulldozers better than the Kabloona—the White Men. They quickly learn how to maintain and repair all types of machinery, and no visitor can ever learn as much as they already know about Artic conditions. As Lord Ritchie-Calder reports:

That is why they call the Eskimo *Innuit*, the Real Man. They know that *Kabloona* cannot exist in Eskimo country without a welter of civilized equipment such as heated houses, radios, aircraft, supply ships, and so on, while everything an Eskimo family needs to sustain life under the harshest conditions can be carried on a single dog sledge. When *Kabloona* goes traveling by land it is *Innuit* who must show him the way. So, since he can learn White Man's ways quicker than the White Man can learn his, the Eskimo, without arrogance, knows that he is the Real Man.[7]

Like the Innuits, other Third World culture groups may prove able to master Kabloona's technology more quickly than the White Man can learn Innuit's independence or flexibility. Perhaps only societies which for centuries have respected nature can adapt technology in a non-Promethean mode. Can it be that only cultures which cherish community and kin relationships have long-range survival capacities in a world where competition will prove to be not only socially rapacious but dysfunctional to survival as well? "Conciliatory" speeches from First World leaders purvey a "trickle down" imagery: the rich are to get still richer but, in the process, something will be left over for the poor to improve their lot.[8] This view is hardly calculated to induce, in arenas of global development, a "wisdom to match our sciences." On the contrary, it exacerbates the very inequalities which technology breeds and which in turn reinforce technology's own tendency to become a self-validating end.

In international discussions, "developed" countries display a terminological schizophrenia parallel to the one they employ domestically. The French political theorist Raymond Aron contends that

> industrial societies proclaim an egalitarian conception of society; yet at the same time they give rise to collective organizations which are increasingly gigantic and to which individuals are progressively more integrated. They spread an egalitarian conception but create hierarchical structures. Thus every industrial society needs an ideology to fill up the gap between what men live and what, according to ideas, they ought to live. We observe an extreme form of this contradiction in Soviet society where, in the name of an ideology of abundance, consumption is curtailed as much as possible in order to increase the power of the collectivity. And the American ideology which allows the reconciliation of hierarchic structure with the egalitarian ideal is the ancient formula: "Every infantryman carries in his knapsack a field marshal's baton."[9]

Dichotomies between rhetoric and reality flow necessarily from technology's character as simultaneous bearer and destroyer of values. Technologies of persuasion and image-making "transform culture into luxury"[10] and atrophy the capacity to innovate. Technical integration so totally absorbs even revolution that "the supreme luxury of the technical society will be to grant the bonus of useless revolt and of an acquiescent smile,"[11] Scott Buchanan sees Ellul's warning as a summons

> to recover our truly scientific understandings, our objective knowledge of our ends and the ends of nature, and our individual and common wills. This might give us back our reverence and love of nature as well as our shrewd ingenuities in exploiting it.[12]

Optimism with respect to developed countries seems unfounded, however, for even in times of crisis they seem unable to demystify technology. As a result, many observers place their hopes in the Third World. The Palestinian physicist A. B. Zahlan observes that

> these undeveloped human cultural entities may be structures within which fresh and non-Western relationships between science, technology and man appear that may help resolve the numerous diseases of Western society. In other words, it is in the very interest of Western society and the human race to restrain their cultural imperialism and/or to find measures to promote native creativity in Third World countries.[13]

Indeed the very inability of some poor nations to achieve "development" may prove a blessing in disguise, enabling them to avoid that economic "cannibalism" by which nations devour their own prosperity.[14]

Technological idolatry confirms in societies alienating forms of development. This is no argument for rejecting technology, although technological optimists tend to brand any critique of technology as intellectual Ludditism. Criticism, however, is a plea for cultural wisdom to guide technology. And as E. F. Schumacher writes,

> wisdom demands a new orientation of science and technology towards the organic, the gentle, the non-violent, the elegant and beautiful. . . . We must look for a revolution in technology to give us inventions and machines which reverse the destructive trends now threatening us all.[15]

Theorists of social change speak of "viable" and "unviable" nations, warning us that many extant cultures may prove unable to assimilate technology without "losing their soul." Ironically, however, today's technologically "advanced" societies may well be the first to fall victim to generalized anomie, to which they have rendered themselves vulnerable by their pursuit of gigantic size, their compulsive voracity to consume, and their impotence in rewarding creativity except in modes which reinforce technology's sway. The collapse of the industrial world would not surprise Toynbee, however; one recurring theme in his *Study of History* is the existence of an inverse relationship between the cultural level of societies and their degree of technological attainments.[16] Given that any human group's psychic energy is limited, if it channels most of it to solve technological problems, little is left for truly civilizational creativity in esthetic and spiritual domains. The price paid for success in science and technology is often regression on more important fronts, a societal analogue of the tragic persona familiar to our age: the brilliant scientist or industrialist who is emotionally a child and politically an idiot. Toynbee writes that

> man's intellectual and technological achievements have been important to him, not in themselves, but only in so far as they have forced him to face, and grapple with, moral issues which otherwise he might have managed to go on shirking. Modern Science has thus raised moral issues of profound importance, but it has not, and could not have, made any contribution towards solving them. The most important questions that Man must answer are questions on which Science has nothing to say.[17]

The "developed" West may be obliged to return to a hierarchy of values like that which characterized China during the "Middle Ages." Harvard's Everett Mendelsohn, an historian of science, thinks that

> had a visitor from Mars dropped down then, roughly any time from the 5th Century B.C. to the 15th Century A.D., Europe would have seemed the least likely place for the technological revolution to occur . . . for technique to be introduced as *the* rationale of human activity. China, I would guess, would have seemed a much likelier place. Its technology was far more developed; it had a more rationalized commerce and was a more sophisticated bureaucracy. The mandarins made their counterparts in the Vatican look like peasants in terms of the use of knowledge, of written language, of symbolism, and in terms of *their understanding of the position of technique in human life*.[18]

Modern China has turned its back on Confucianism, but its revolutionaries subordinate technique to politics and values. China's early experience with Western technology taught it the lesson that uncritical acceptance of technology leads ultimately to competition, waste, and exploitation. Because technology has to be subordinated to other values, all societies, "developed" and "underdeveloped" alike, will need to revitalize their traditions to serve their future.[19]

One conclusion reached in the present study is that technology can be controlled if it is not sought as an absolute. Paradoxically, technology is indispensable in struggles against the miseries of underdevelopment and against the peculiar ills of overdevelopment. Technology can serve these noble purposes, however, only in those societies in which ideology, values, and decisional structures repudiate the tendency of technology to impose its own logic in striving after goals. Toynbee hopes for the advent of wisdom from efforts by the world's higher religions—Buddhism, Hinduism, Islam, Judaism, and Christianity—to come to terms with universalism and secularism. Lewis Mumford prefers to remind us that civilizations of the past

> did not regard sicentific discovery and technological invention as the sole object of human existence; for I have taken life itself to be the primary phenomenon, and creativity, rather than the 'conquest of nature,' as the ultimate criterion of man's biological and cultural success.[20]

Glorifying life and creativity, however, does not guarantee the fullness of their development. Life also comes to an end, and civilizations too, as Paul Valéry poignantly reminds us, are mortal. And technological creativity can be put to destructive purposes. This danger revives ancient philosophical questions as to the meaning of death, of suffering, of tragedy, of ultimate meaning.[21] All known civilizations have answered these questions in religious, albeit not always in transcendental, terms. Consequently, the religious myth of Prometheus illuminates the destiny of civilizations in a post-technological age.

If humankind is a despairing Prometheus plagued by guilt over having stolen from heaven the devine fire called technology, it cannot avoid being enslaved by its own creation. If, on the other hand, humankind accepts technology as a free gift of the gods enabling the construction of a better world and a closer affinity with the divine, it remains possible for human beings *not* to fall into the idolatry trap.[22] It is no accident that it is precisely within allegedly "one-dimensional" societies like the United States that the strongest voices are heard warning against the twin evils of antitechnological idiocy and romantic technological optimism. Myron Bloy, a theologian and author of *The Crisis of Technological Change,* sees technology bringing new freedoms and new capacities for basing an emerging culture on critically defined norms and values. He explains that, during the technological era,

> God is, in effect, kicking us in the pants and telling us that it is time to grow up. We are given the tools needed to shape a new culture and allowed to use them effectively only in the service of a prophetic committment. . . . There is no assurance that society will accept this challenge rather than hide in increasingly frenzied operationalism or increasingly brittle idealisms until we are overwhelmed by chaos, but these are our only two options.[23]

These two options now confront not the United States alone but the entire world. The first choice is prophetic commitment to peace, justice, material sufficiency for all, ecological integrity, and the rebirth of vital cultural diversity.[24] The alternative, inevitable if the first option is declined, is chaos: exploitative development for the few at the expense of the many war-making, technological servitude, ecological pathology, and the reification of all human values.

This study of values conflicts in technology transfer has attempted to peel away the mystifications which veil the true impact of technology on societies nurturing diverse images of development. Technology is revealed herein as a two-edged sword, simultaneously bearer and destroyer of values. Yet technology is not static: it is a dynamic and expansionist social force which provides a "competitive edge" enabling its possessors to conquer economic, political, and cultural power. Consequently, Third World efforts to harness technology to broader developmental goals are paradigmatic of a still greater task: to create a new world order founded not on elitism, privilege, or force but on effective solidarity in the face of human needs. The gestation of a new world order poses two troubling questions for all societies: Can technology be controlled, and will culture survive?

To these two questions the answer is a qualified yes. But several conditions must first be met. Those who aspire to master technology must learn to look critically and constructively at their own cultural wisdom. This searching look at the past is needed if they are to escape the reductionism which impregnates the technological cast of mind. It is to be hoped that out of the confrontation between past values and present technological necessities may emerge new sources of life, creativity, and organic thinking.

New forms of knowledge must be born. French sociologist Edgar Morin pleads for

> a restructuring of the general shape of knowledge . . . a totally new conception of science itself which will challenge and overturn not only established boundaries among disciplines but the very cornerstones of all paradigms and, in a sense, the scientific institution itself.[25]

Only thus can human knowledge adequately explain "the anthropological trinity of species, society, and the individual."[26]

The revitalization of traditions, values, and wisdoms in the light of modern technological challenges and the construction of new modes of understanding must occur at two levels. While particular loyalties and values are revived, more universal attachments to a global order must also gain sway. World-order thinking is essential, writes Indian economist Rajni Kothari, because

> it is no longer possible to bring about successful change of an enduring kind in one area or country, except in very marginal ways, without taking account of the world context. Even revolutions suffer from this limitation. Similarly, no amount of either pleading or moralizing to restrain standards of consumption or curb 'chauvinist' tendencies is likely to go far in the poorer regions unless at the same time a similar onslaught is directed at the citadels of affluence and the centres of political and military dominance.[27]

New planetary bargains must be struck between the rich and poor, the technologically advanced and those less so.[28]

Can a global order promote just development, technological wisdom, ecological health, and reciprocity among all societies? The options are posited by Reimer in these terms:

> Effective curtailment of world population and of energy and other technological uses will require either a world dictatorship, for which history pro-

vides no model, or an ethical social order for which there is even less historic precedent. Failing control by one of these means, the industrial world cannot survive. If the industrial world breaks down, however, only the same alternatives remain as suitable models for a viable new social order. In this case, however, an additional possibility occurs; namely, that no reconstruction but an indefinite period of barbarism might ensue.[29]

The "developed" West has shaped modern technology and aggressively exported it to other societies, most of whom received it avidly. While processes of technology transfer have solved innumerable problems, they have likewise destroyed many of the cultural values societies need to achieve a wisdom to match their sciences. The tragic truth is, as Mumford writes, that

> Western man not merely blighted in some degree every culture that he touched, whether "primitive" or advanced, but he also robbed his own descendants of countless gifts of art and craftmanship, as well as precious knowledge passed on only by word of mouth that disappeared with the dying languages of dying peoples.[30]

Many Third World leaders resignedly accept the destruction of their own cultures in order to gain modernity. A general uneasiness has come to prevail, therefore, in all areas where development is discussed. Visions of brave new worlds are no longer euphoric; even erstwhile champions of development have grown fearful of apocalypse. Especially in the rich world, social critics grow weary and pessimistic and come to fear developmental change.[31] All societies, developed and nondeveloped, are being forced to make what French philosopher J.M. Domenach calls a "return to the tragic."[32] No longer do any certitudes exist regarding the course of technology or the future of humankind. Yet this very obscurity is salutary; our age has learned that easy certitudes are mere tranquilizers peddled in the markets of meaning.

Technology is no panacea for the ills of underdevelopment; even at best its promise is uncertain. And no romantic flight from technology can bring salvation from the alienation specific to "developed" societies. For every historical experience of social change is, as Domenach reminds us, true tragedy "thrusting us to the very heart of those relations which any society has of its own self-image, its language, its history and its future."[33]

As all societies struggle to create a world of genuine development, value conflicts will endure. But these conflicts, like technology itself, can prove beneficial. The key lies in the criteria chosen to decide which values will be destroyed and which will be preserved. Technology is indeed a two-edged sword, at once beneficent and destructive. But so is development itself. So is all of human history.

NOTES

1. James Harvey Robinson, "Civilization and Culture," in *Encyclopedia Britannica*, 14th ed., 23 vols. (Chicago: William Benton, 1969), vol. 5, p. 831.
2. Arnold J. Toynbee, *Civilization on Trial* (New York: Oxford University Press, 1948), p. 158.
3. John White, "What Is Development? And for Whom? (Paper presented at Quaker Conference on "Motive Forces in Development," Hammamet, Tunisia, April 1972), p. 41.
4. Toynbee, *Civilization on Trial*, p. 86.
5. Ibid., p. 91.
6. Cf. Toynbee, *Civilization on Trial*, pp. 70, 158.
7. Lord Ritchie-Calder, *After the Seventh Day: The World Man Created* (New York: Simon and Schuster, 1961), p. 19. For a more detailed and scientific portrait of the adaptability of the Innuits, cf. Sixten S. R. Haraldson, *Evaluation of Alaska Native Health Service* (Report of a study trip, December 1972/January 1973, prepared for the World Health Organization, Geneva).
8. See, for example, the address of Henry Kissinger before the St. Louis World Affairs Council, 12 May 1975. (Text available from US Department of State, Bureau of Media Affairs, Washington. D.C.)

   Although widely hailed as being "generous" and attentive to Third World needs, the speech nonetheless betrays the assumption that 25% of the world's population has every right to 75% of its resources and that the United States, in particular, need feel no uneasiness in controlling at least 30% of these resources to satisfy its mere 6% of the world's peoples. No mention is made of the risk that the pursuit by Americans of still further material wealth can endanger the biosphere and inflict physical and genetic damage on future generations.
9. Raymond Aron, *Dix-huit leçons sur la societé industrielle* (Paris: Gallimard, 1962), p. 361. Translation mine.
10. Jacques Ellul, *The Technological Society*, p. 424.
11. Ibid., p. 427.
12. Scott Buchanan, "Technology as a System of Exploitation," in *The Technological Order*, ed. Carl F. Stover (Detroit: Wayne State University Press, 1963), p. 159.
13. A.B. Zahlan, "Cultural Change and Cultural Transfer: A Preliminary Assessment of Present Conditions" (n.p., 6 September 1973), mimeographed, p. 2.
14. The phrase is Lord Ritchie-Calder's, in his *After the Seventh Day*, p. 427.
15. Quoted in Nicholas Wade, "E. F. Schumacher: Cutting Technology Down to Size," *Science*, vol. 189, no. 4198 (18 July 1975), p. 199.
16. Arnold J. Toynbee, *A Study of History*, 10 vols.,

abridgment by D. C. Somervell, in 2 vols. (New York: Dell, 1965), vol. 1, pp. 59, 379, 382.

17. Ibid., vol. 2, p. 116.
18. Everett Mendelsohn, "The Ethical Implications of Western Technology for Third World Communities" (Address delivered at the Massachusetts Institute of Technology Seminar on Technology and Culture, Cambridge, Mass., 19 November 1974). Italics mine. For a revealing portrait of the differences to which Mendelsohn alludes, see *China in the Sixteenth Century: The Journals of Matteo Ricci, 1583-1610* (New York: Random House, 1953). Also Vincent Cronin, *The Wise Man from the West* (Garden City, N.Y.: Doubleday, 1957).
19. Cf. Mirrit Boutros Ghali, *Tradition for the Future* (Oxford: The Alden Press, 1972).
20. Lewis Mumford, *The Myth of the Machine*, 2 vols. (New York: Harcourt Brace Jovanovich, 1970), vol. 2, *The Pentagon of Power*, foreword.
21. On these themes, see Jeanne Hersch, "Comments on 'Industrial Society and the Good Life,'" in *World Technology and Human Destiny*, ed. Raymond Aron (Ann Arbor: University of Michigan Press, 1963), pp. 195-196.
22. See Thomas Merton, "A Note: Two Faces of Prometheus," in *The Behavior of Titans* (New York: New Directions, 1961), pp. 11-23.
23. Myron B. Bloy, Jr., "Technology and Theology," in *Dialogue on Technology*, ed. Robert Theobald (Indianapolis: Bobbs-Merrill, 1967), p. 89.
24. Cf. Arend T. van Leeuwen, *Prophecy in a Technocratic Era* (New York: Scribner's, 1968).
25. Edgar Morin, *Le paradigme perdu: la nature humaine* (Paris: Editions du Seuil, 1970), p. 229. Translation mine.
26. Ibid., p. 199.
27. Rajni Kothari, *Footsteps into the Future* (New York: The Free Press, 1974), p. 9.
28. See John and Magda C. McHale, *Human Requirements, Supply Levels and Outer Bounds: A Framework for Thinking About the Planetary Bargain* (Policy paper of the Aspen [Colo.] Institute for Humanistic Studies, Program in International Affairs, 1975); also, *The Planetary Bargain: Proposals for a New International Economic Order to Meet Human Needs* (Report of an International Workshop, Aspen Institute for Humanistic Studies, 7 July-1 August 1975)
29. Everett Reimer, "Alternative Futures for the World," unpublished book manuscript (n.p., June 1973), p. 2.
30. Mumford, *The Pentagon of Power*, pp. 10-11.
31. Examples are Robert L. Heilbroner, *An Inquiry into the Human Prospect* (New York: Norton, 1974); Barrington Moore, Jr., *Reflections on Causes of Human Misery* (Boston: Beacon, 1972); and Peter Berger, *Pyramids of Sacrifice* (New York: Basic Books, 1974).
32. Jean-Marie Domenach, *Le rétour du tragique* (Paris: Editions du Seuil, 1967).
33. Ibid, p. 13.

THIRD WORLD

Contemporary Western man between the rim and the axis

SEYYED HOSSEIN NASR

■ Seyyed Hossein Nasr *was born in 1933 in Teheran. He was educated at the Massachusetts Institute of Technology and has taught at institutions all over the world, including Harvard and the American University of Beirut. He was until recently director of the Imperial Iranian Academy of Philosophy and chancellor of Aryamehr University in Tehran. Nasr is interested in the traditional and sacred arts, and has published widely in the areas of philosophy, history, and religion. Among his works are* Science and Civilization in Islam *(1968) and* Encounter of Man and Nature *(1968).*

In Islam and the Plight of Modern Man *(1975), Nasr expounds the Islamic intellectual and spiritual heritage as the way out of the morass in which contemporary Western man finds himself. This short selection discusses the problem of* amnesis, *or forgetfulness, in modern man. "Modern man has simply forgotten who he is" and, like Faust, has sold his soul "to gain dominion over the natural environment" and to create "a situation in which the very control of the environment is turning into its strangulation, bringing in its wake not only ecocide but also, ultimately, suicide."*

The basis of this crisis is man's misconception of his own nature. In his rebellion against heaven, man has attempted to understand his nature through a "scientific" study of fragmented human behaviour. But that has given him only external and superficial knowledge of himself. It has not given him knowledge of the essential characteristics of human nature, including its spiritual dimension. Such knowledge can be achieved only through an awareness of interiority, a direct awareness of the self in the light of God.

The confrontation of man's own inventions and manipulations, in the form of technology, with human culture, as well as the violent effect of the application of man's acquired knowledge of nature to the destruction of the natural environment, have in fact reached such proportions that many people in the modern world, especially in the West, are at last beginning to question the validity of the conception of man held in the Occident since the rise of modern civilization. But, despite this recent awareness, in order to discuss such a vast problem in a meaningful and constructive way, one must begin by clearing the ground of the obstacles which usually prevent the profoundest questions involved from being discussed. Modern man has burned his hands in the fire which he himself kindled when he allowed himself to forget who he is. Having sold his soul in the manner of Faust to gain dominion over the natural environment, he has created a situation in which the very control of the environment is turning into its strangulation, bringing in its wake not only ecocide but also, ultimately, suicide.

The danger is now evident enough not to need repetition. Whereas only two decades ago everyone spoke of man's unlimited possibility for development understood in a physical and materialistic sense, today one speaks of "limits to growth"—a phrase well-known in the West today—or even of an imminent cataclasm. But the concepts and factors according to which the crisis is analyzed, the solutions sought after and even the colours with which the image of an impending doom are depicted are usually all in terms of the very elements that have brought the crisis of modern man into being. The world is still seen as devoid of a spiritual horizon, not because there is no such horizon present, but because he who views the contemporary landscape is most often the man who lives at the rim of the wheel of existence and therefore views all things from the periphery. He remains indifferent to the spokes and completely oblivious of the axis or the Centre, which nevertheless remains ever accessible to him through them.

The problem of the devastation brought upon the environment by technology, the ecological crisis and the like, all issue from the malady of *amnesis* or forgetfulness from which modern man suffers. Modern man has simply forgotten who he is. Living on the periphery of his own existence he has been able to gain a qualitatively superficial but quantitatively staggering knowledge of the world. He has projected the externalized and superficial image of himself upon the world.[1] And then, having come to know the world in such externalized terms, he

☐ From *Islam and the Plight of Modern Man* (London: Longman Group Ltd., 1975), pp. 3-7.

has sought to reconstruct an image of himself based upon this external knowledge. There has been a series of ''falls'' by means of which man has oscillated in a descending scale between an ever more externalized image of himself and of the world surrounding him, moving ever further from the Centre both of himself and of his cosmic environment. The inner history of the so-called development of modern Western man from his historic background as traditional man—who represents at once his ancestor in time and his centre in space—is a gradual alienation from the Centre and the axis through the spokes of the wheel of existence to the rim, where modern man resides. But just as the existence of the rim presupposes spokes which connect it to the axis of the wheel, so does the very fact of human existence imply the presence of the Centre and the axis and hence an inevitable connection of men of all ages with Man in his primordial and eternal reality as he has been, is, and will continue to be, above all outward changes and transformations.[2]

Nowhere is the tendency of modern man to seek the solution of many problems without considering the factors that have caused these problems in the first place more evident than in the field of the humanities in general and the sciences dealing specifically with man, which are supposed to provide an insight into human nature, in particular. Modern man, having rebelled against Heaven, has created a science based not on the light of the Intellect[3]—as we see in the traditional Islamic sciences—but on the powers of human reason to sift the data of the senses. But the success of this science was so great in its own domain that soon all the other sciences began to ape it, leading to the crass positivism of the past century which caused philosophy as perennially understood to become confused with logical analysis, mental acrobatics or even mere information theory, and the classical fields of the humanities to become converted to quantified social sciences which make even the intuitions of literature about the nature of man inaccessible to many students and seekers today. A number of scientists are in fact among those most critical of the pseudo-humanities being taught in many Western universities in an atmosphere of a psychological and mental sense of inferiority *vis-à-vis* the sciences of nature and mathematics, a ''humanities'' which tries desperately to become ''scientific'', only to degenerate into a state of superficiality, not to say triviality.[4] The decadence of the humanities in modern times is caused by man's loss of the direct knowledge of himself and also of the Self that he has always had, and by reliance upon an externalized, indirect knowledge of himself which he seeks to gain from the outside, a literally ''superficial'' knowledge that is drawn from the rim and is devoid of an awareness of interiority, of the axis of the wheel and of the spokes which stand always before man and connect him like a ray of light to the supernal sun.

It is with a consideration of this background that certain questions created by the confrontation between the traditional concept of man and the ''scientific'' one must be analyzed and answered. The first of these questions that often arise in people's minds is ''What is the relation of piecemeal scientific evidence about human behaviour to what has been called traditionally 'human nature'?'' In order to answer this question it is essential to remember that the reality of the human state cannot be exhausted by any of its outward projections. A particular human action or behaviour always reflects a state of being, and its study can lead to a certain kind of knowledge of the state of being of the agent provided there is already an awareness of the whole to which the fragment can be related. Fragmented knowledge of human behaviour is related to human nature in the same way that waves are related to the sea. There is certainly a relationship between them that is both causal and substantial. But unless one has had a vision of the sea in its vastness and illimitable horizons—the sea which reflects the Infinite and its inimitable peace and calm—one cannot gain an essential knowledge of it through the study of its waves. Fragmented knowledge can be related to the whole only when there is already an intellectual vision of the whole.

The careful ''scientific'' study of fragmented human behaviour is incapable of revealing the profounder aspect of human nature precisely because of an *a priori* limitation that so many branches of the modern behaviouristic sciences of man—veritable pseudo-sciences if there ever were any[5]—have placed on the meaning of the human state itself. There has never been as little knowledge of man, of the *anthropos*, in different human cultures as one finds among most modern anthropologists today. Even the medicine men of Africa (not to speak of the Muslim sages) have had a deeper insight into human nature than the modern behaviourists and their flock, because the former have been concerned with the essential and the latter with the accidental. Now, accidents do possess a reality, but they have a meaning only in relation to the substance which supports them ontologically. Otherwise one could collect accidents and external facts indefinitely without ever reaching the substance, or what is essential. The classical error of modern civilization, to mistake the quantitative accumulation of information for qualitative penetration into the inner meaning of things, applies here as elsewhere. The study of fragmented behaviour without a vision of the human nature which is the cause of this behaviour cannot itself lead to a knowledge of human nature. It can go around the rim of the wheel indefinitely without ever entering upon the spoke to approach the proximity of the axis and the Centre. But if the vision is already present, the gaining of knowledge of external human behaviour can always be an occasion for recollection and a return to the cause by means of the external effect.

In Islamic metaphysics, four basic qualities are attributed to Ultimate Reality, based directly on the Quranic verse, "He is the First and the Last, the Outward and the Inward" (LVII; 3). This attribution, besides other levels of meaning, also has a meaning that is directly pertinent to the present argument. God, the Ultimate Reality, is both the Inward *(al-Bāṭin)* and the Outward *(al-Ẓāhir),* the Centre and the Circumference. The religious man sees God as the Inward; the profane man who has become completely oblivious to the world of the Spirit sees only the Outward, but precisely because of his ignorance of the Centre does not realize that even the outward is a manifestation of the Centre or of the Divine. Hence his fragmented knowledge remains incapable of encompassing the whole of the rim or circumference and therefore, by anticipation, the Centre. A segment of the rim remains nothing more than a figure without a point of reference or Centre, but the whole rim cannot but reflect the Centre. Finally the sage sees God as both the Inward and the Outward. He is able to relate the fragmented external knowledge to the Centre and see in the rim a reflection of the Centre. But this he is able to do only because of his *a priori* awareness of the Centre. Before being able to see the external world—be it the physical world about us or the outer crust of the human psyche—as a manifestation of the Inward, one must already have become attached to the Inward through faith and knowledge.[6] Applying this principle, the sage could thus relate fragmented knowledge to the deeper layers of human nature; but for one who has yet to become aware of the Inward dimension within himself and the Universe about him, fragmented knowledge cannot but remain fragmentary, especially if it is based upon observation of the behaviour of a human collectivity most of whose members themselves live only on the outermost layers of human existence and rarely reflect in their behaviour the deeper dimension of their own being.

This last point leads to an observation that complements the discussion of principles already stated. Western man lives for the most part in a world in which he encounters few people who live on the higher planes of consciousness or in the deeper layers of their being. He is therefore, for the most part, aware of only certain types of human behaviour, as can be readily seen in the writings of most Western social scientists, especially when they make studies of such traditions as Islam. Fragmented knowledge of human behaviour, even if based solely on external observation, could aid modern man to become at least indirectly aware of other dimensions of human nature, provided a study is made of the behaviour of traditional man—of the man who lives in a world with a Centre. The behaviour of traditional men of different societies, especially at the highest level of the saints and sages—be they from the Chinese, the Islamic, the North American Indian or any other traditional background—in the face of great trials, before death, in presence of the beauty of virgin nature and sacred art, or in the throes of love both human and divine, can certainly provide indications of aspects of human nature for the modern observer. Such behaviour can reveal a constancy and permanence within human nature that is truly astonishing and can also be instrumental in depicting the grandeur of man, which has been largely forgotten in a world where he has become a prisoner to the pettiness of his own trivial creations and inventions. Seen in this light, a fragmented knowledge of human behaviour can aid in gaining a knowledge of certain aspects of human nature. But in any case a total knowledge of this nature cannot be achieved except through a knowledge of the Centre or axis, which also "contains" the spokes and the rim. A famous saying of the Prophet of Islam states, "He who knows himself knows his Lord". But precisely because "himself" implies the Self which resides at the Centre of man's being, from another point of view this statement can also be reversed. Man can know himself completely only in the light of God, for the relative cannot be known save with respect to the Absolute.

NOTES

1. It must be remembered that, in the West, man first rebelled against Heaven with the humanism of the Renaissance; only later did the modern sciences come into being. The humanistic anthropology of the Renaissance was a necessary background for the scientific revolution of the seventeenth century and the creation of a science which, although in one sense non-human, is in another sense the most anthropomorphic form of knowledge possible, for it makes human reason and the empirical data based upon the human senses the sole criteria for the validity of all knowledge.

   Concerning the gradual disfiguration of the image of man in the West, see G. Durand, 'Défiguration philosophique et figure traditionnelle de l'homme en Occident', *Eranos-Jahrbuch*, XXXVIII, 1971, pp. 45-93.
2. If such a relation did not exist, it would not even be possible for man to identify himself with other periods of human history, much less for the permanent aspects of human nature to manifest themselves even in the modern world as they have in the past and continue to do today.
3. Throughout this book the word 'intellect' is used in its original Latin sense as *intellectus* or the Greek *nous*, which stands above reason and is able to gain knowledge directly and immediately. Reason is only the reflection of the intellect upon the mirror of the human mind.
4. There is little more pathetic in this type of pseudo-humanities than the attempt now being made in some Islamic countries to introduce this decadence into the very bosom of Islamic culture in the name of progress.

   Certain American scholars such as William Arrowsmith and William Thompson have already criticized what could be called the "pollution of the humanities", but the tendency in this field as in the question of the pollution of the environment is mostly to try to remove the ill effects without curing the underlying causes.
5. In modern times, the occult sciences, whose metaphysical principles have been forgotten, have become known as the "pseudo-sciences", while in reality they contain a profound doctrine concerning the nature of man and the cosmos, provided their symbolism is understood. Much of the social and human sciences today on the contrary veil and hide a total ignorance of human nature with a scientific garb and are, in a sense, the reverse of the occult sciences. Hence they deserve much more than the occult sciences the title of "pseudo-science".
6. This theme is thoroughly analyzed by F. Schuon in his *Dimensions of Islam*, trans. by P. Townsend, London, 1970, Chapter 2. Concerning the sage or the Sufi, he writes: "The Sufi lives under the gaze of *al-Awwal* (the First), *al-Ākhir* (the Last), *al-Zāhir* (the Outward) and *al-Bātin* (the Inward). He lives concretely in these metaphysical dimensions as ordinary creatures move in space and time, and as he himself moves in so far as he is a mortal creature. He is consciously the point of intersection where the Divine dimensions meet; unequivocally engaged in the universal drama, he suffers no illusions about impossible avenues of escape, and he never situates himself in the fallacious 'extra-territoriality' of the profane, who imagine that they can live outside spiritual Reality, the only reality there is." pp. 36-37.

THIRD WORLD

Man's nature

RABINDRANATH TAGORE

■ Rabindranath Tagore *(1861-1941) was a Bengali poet, philosopher, and social reformer. He came from an affluent and highly talented Calcutta family. Like Mohandas Gandhi, whom he knew, Rabindranath (as he was known to his people) abhorred violence. He was a simple and gentle person who was full of humor and love of life. His most famous work is* Gitanjali *(song offerings), a collection of poems with an introduction by Yeats, who was highly moved by them. It was this book that earned Tagore his Nobel Prize for literature (1913) and thrust him into international prominence.*

In the following excerpt from another work, The Religion of Man *(1931), Tagore expounds the notion of* dharma, *or the "virtue of a thing." Man has a* dharma; *it is his humanity. Furthermore, "civilization is to express Man's* dharma *and not merely his cleverness, power and possessions." Anything short of this description is not civilization.*

Tagore seems to be suspicious of modern gadgetry in particular. Recalling a childhood playmate who felt superior to his peers for possessing a toy bought from an English shop, Tagore observes: "One thing he failed to realize in his excitement . . . that this temptation [the toy] obscured something a great deal more perfect than his toy . . . the dharma *of the child." The playmate's peers constantly used their imagination for creating new games. But his toy removed his need for such an approach. Tagore thus advocates simplicity in the material aspects of life in order to give the imaginative and spiritual faculties of man the ability to blossom and create a higher civilization.*

From the time when Man became truly conscious of his own self he also became conscious of a mysterious spirit of unity which found its manifestation through him in his society. It is a subtle medium of relationship between individuals, which is not for any utilitarian purpose but for its own ultimate truth, not a sum of arithmetic but a value of life. Somehow Man has felt that this comprehensive spirit of unity has a divine character which could claim the sacrifice of all that is individual in him, that in it dwells his highest meaning transcending his limited self, representing his best freedom.

Man's reverential loyalty to this spirit of unity is expressed in his religion; it is symbolized in the names of his deities. That is why, in the beginning, his gods were tribal gods, even gods of the different communities belonging to the same tribe. With the extension of the consciousness of human unity his God became revealed to him as one and universal, proving that the truth of human unity is the truth of Man's God.

In the Sanskrit language, religion goes by the name *dharma*, which in the derivative meaning implies the principle of relationship that holds us firm, and in its technical sense means the virtue of a thing, the essential quality of it; for instance, heat is the essential quality of fire, though in certain of its stages it may be absent.

Religion consists in the endeavour of men to cultivate and express those qualities which are inherent in the nature of Man the Eternal, and to have faith in him. If these qualities were absolutely natural in individuals, religion could have no purpose. We begin our history with all the original promptings of our brute nature which helps us to fulfil those vital needs of ours that are immediate. But deeper within us there is a current of tendencies which runs in many ways in a contrary direction, the life current of universal humanity. Religion has its function in reconciling the contradiction, by subordinating the brute nature to what we consider as the truth of Man. This is helped when our faith in the Eternal Man, whom we call by different names and imagine in different images, is made strong. The contradiction between the two natures in us is so great that men have willingly sacrificed their vital needs and courted death in order to express their *dharma*, which represents the truth of the Supreme Man.

The vision of the Supreme Man is realized by our imagination, but not created by our mind. More real than individual men, he surpasses each of us in his permeating personality which is transcendental. The procession of his ideas, following his great purpose, is ever moving across obstructive facts towards the perfected truth. We, the individuals, having our place in his composition, may or may not be in conscious harmony with his purpose, may even put obstacles in his path bringing down our doom upon ourselves. But we gain our true religion when we consciously co-operate with him, finding our exceeding joy through suffering and sacrifice. For through our own love for him we are made conscious of a great love that radiates from his being, who is Mahātma, the Supreme Spirit.

The great Chinese sage Lao-tze has said: "One who may die, but will not perish, has life everlasting". It means that he lives in the life of the immortal Man. The urging for this life induces men to go through the struggle for a true survival. And it has been said in our scripture: "Through *adharma* (the negation of *dharma*) man prospers, gains what appears desirable, conquers enemies, but he perishes at the root." In this saying it is suggested that there is a life which is truer for men than their physical life which is transient.

Our life gains what is called "value" in those of its aspects which represent eternal humanity in knowledge, in sympathy, in deeds, in character and creative works. And from the beginning of our history we are seeking, often at the cost of everything else, the value for our life and not merely success; in other words, we are trying to realize in ourselves the immortal Man, so that we may die but not perish. This is the meaning of the utterance in the Upanishad: *"Tam vedyam purusham veda, yatha ma vo mrityuh parivyathah"* —"Realize the Person so that thou mayst not suffer from death."

The meaning of these words is highly paradoxical, and cannot be proved by our senses or our reason, and yet its influence is so strong in men that they have cast away all fear and greed, defied all the instincts that cling to the brute nature, for the sake of acknowledging and preserving a life which belongs to the Eternal Person. It is all the more significant because many of them do not believe in its reality, and yet are ready to fling away for it all that they believe to be final and the only positive fact.

We call this ideal reality "spiritual". That word is vague; nevertheless, through the dim light which reaches us across the barriers of physical existence, we seem to have a stronger faith in the spiritual Man than in the physical; and from the dimmest period of his history, Man has a feeling that the apparent facts of existence are not final; that his supreme welfare depends upon his being able to remain in perfect relationship with some great mystery behind the veil, at the threshold of a larger life, which is)r giving him a far higher value than a mere)ntinuation of his physical life in the material 'orld.

Our physical body has its comprehensive :ality in the physical world, which may be uly called our universal body, without which ır individual body would miss its function. 'ur physical life realizes its growing meaning ırough a widening freedom in its relationship 'ith the physical world, and this gives it a reater happiness than the mere pleasure of satfied needs. We become aware of a profound ıeaning of our own self at the consciousness f some ideal of perfection, some truth beautiful r majestic which gives us an inner sense of)mpleteness, a heightened sense of our own :ality. This strengthens man's faith, effective /en if indefinite—his faith in an objective ideal f perfection comprehending the human world. is vision of it has been beautiful or distorted, ıminous or obscure, according to the stages of evelopment that his consciousness has atined. But whatever may be the name and naıre of his religious creed, man's ideal of huıan perfection has been based upon a bond of ıity running through individuals culminating ı a supreme Being who represents the eternal ı human personality. In his civilization the per:ct expression of this idea produces the wealth f truth which is for the revelation of Man and)t merely for the success of life. But when ıis creative ideal which is *dharma* gives place) some overmastering passion in a large body f men civilization bursts out in an explosive ame, like a star that has lighted its own funeral yre of boisterous brilliancy.

When I was a child I had the freedom to make ıy own toys out of trifles and create my own ımes from imagination. In my happiness my laymates had their full share, in fact the comlete enjoyment of my games depended upon ıeir taking part in them. One day, in this parase of our childhood, entered the temptation om the market world of the adult. A toy rought from an English shop was given to one f our companions; it was perfect, it was big ıd wonderfully life-like. He became proud of ıe toy and less mindful of the game; he kept ıat expensive thing carefully away from us, lorying in his exclusive possession of it, feelıg himself superior to his playmates whose ıys were cheap. I am sure if he could use the ıodern language of history he would say that ɜ was more civilized than ourselves to the extent of his owning that ridiculously perfect toy.

One thing he failed to realize in his excitement—a fact which at the moment seemed to him insignificant—that this temptation obscured something a great deal more perfect than his toy, the revelation of the perfect child which ever dwells in the heart of man, in other words, the *dharma* of the child. The toy merely expressed his wealth but not himself, not the child's creative spirit, not the child's generous joy in his play, his identification of himself with others who were his compeers in his play world. Civilization is to express Man's *dharma* and not merely his cleverness, power and

Once there was an occasion for me to motor down to Calcutta from a place a hundred miles away. Something wrong with the mechanism made it necessary for us to have a repeated supply of water almost every half-hour. At the first village where we were compelled to stop, we asked the help of a man to find water for us. It proved quite a task for him, but when we offered him his reward, poor though he was, he refused to accept it. In fifteen other villages the same thing happened. In a hot country, where travellers constantly need water and where the water supply grows scanty in summer, the villagers consider it their duty to offer water to those who need it. They could easily make a business out of it, following the inexorable law of demand and supply. But the ideal which they consider to be their *dharma* has become one with their life. They do not claim any personal merit for possessing it.

Lao-tze, speaking about the man who is truly good, says: "He quickens but owns not. He acts but claims not. Merit he accomplishes but dwells not in it. Since he does not dwell in it, it will never leave him." That which is outside ourselves we can sell; but that which is one with our being we cannot sell. This complete assimilation of truth belongs to the paradise of perfection; it lies beyond the purgatory of self-consciousness. To have reached it proves a long process of civilization.

To be able to take a considerable amount of trouble in order to supply water to a passing stranger and yet never to claim merit or reward for it seems absurdly and negligibly simple compared with the capacity to produce an amazing number of things per minute. A millionaire tourist, ready to corner the food market and grow rich by driving the whole world to the brink of starvation, is sure to feel too superior to notice this simple thing while rushing through our villages at sixty miles an hour.

Yes, it is simple, as simple as it is for a gentleman to be a gentleman; but that simplicity is the product of centuries of culture. That simplicity is difficult of imitation. In a few years' time, it might be possible for me to learn how to make holes in thousands of needles simultaneously by turning a wheel, but to be absolutely simple in one's hospitality to one's enemy, or to a stranger, requires generations of training. Simplicity takes no account of its own value, claims no wages, and therefore those who are enamoured of power do not realize that simplicity of spiritual expression is the highest product of civilization.

A process of disintegration can kill this rare fruit of a higher life, as a whole race of birds possessing some rare beauty can be made extinct by the vulgar power of avarice which has civilized weapons. This fact was clearly proved to me when I found that the only place where a price was expected for the water given to us was a suburb at Calcutta, where life was richer, the water supply easier and more abundant and where progress flowed in numerous channels in all directions. It shows that a harmony of character which the people once had was lost—the harmony with the inner self which is greater in its universality than the self that gives prominence to its personal needs. The latter loses its feeling of beauty and generosity in its calculation of profit; for there it represents exclusively itself and not the universal Man.

There is an utterance in the Atharva Veda, wherein appears the question as to who it was that gave Man his music. Birds repeat their single notes, or a very simple combination of them, but Man builds his world of music and establishes ever new rhythmic relationship of notes. These reveal to him a universal mystery of creation which cannot be described. They bring to him the inner rhythm that transmutes facts into truths. They give him pleasure not merely for his sense of hearing, but for his deeper being, which gains satisfaction in the ideal of perfect unity. Somehow man feels that truth finds its body in such perfection; and when he seeks for his own best revelation he seeks a medium which has the harmonious unity, as has music. Our impulse to give expression to Universal Man produces arts and literature. They in their cadence of lines, colours, movements, words, thoughts, express vastly more than what they appear to be on the surface. They open the windows of our mind to the eternal reality of man. They are the superfluity of wealth of which we claim our common inheritance whatever may be the country and time to which we belong; for they are inspired by the universal mind. And not merely in his arts, but in his own behaviour, the individual must for his excellence give emphasis to an ideal which has some value of truth that ideally belongs to all men. In other words, he should create a music of expression in his conduct and surroundings which makes him represent the supreme Personality. And civilization is the creation of the race, its expression of the univeral Man.

When I first visited Japan I had the opportunity of observing where the two parts of the human sphere strongly contrasted; one, on which grew up the ancient continents of social ideal, standards of beauty, codes of personal behaviour; and the other part, the fluid element, the perpetual current that carried wealth to its shores from all parts of the world. In half a century's time Japan has been able to make her own the mighty spirit of progress which suddenly burst upon her one morning in a storm of insult and menace. China also has had her rousing, when her self-respect was being knocked to pieces through series of helpless years, and I am sure she also will master before long the instrument which hurt her to the quick. But the ideals that imparted life and body to Japanese civilization had been nourished in the reverent hopes of countless generations through ages which were not primarily occupied in an incessant hunt for opportunities. They had those large tracts of leisure in them which are necessary for the blossoming of Life's beauty and the ripening of her wisdom.

On the one hand we can look upon the modern factories in Japan with their numerous mechanical organizations and engines of production and destruction of the latest type. On the other hand, against them we may see some fragile vase, some small piece of silk, some architecture of sublime simplicity, some perfect lyric of bodily movement. We may also notice the Japanese expression of courtesy daily extracting from them a considerable amount of time and trouble. All these have come not from any accurate knowledge of things but from an intense consciousness of the value of reality which takes time for its fullness. What Japan reveals in her skilful manipulation of telegraphic wires and railway lines, of machines for manufacturing things and for killing men, is more or less similar to what we see in other countries which have similar opportunity for training. But in her art of living, her pictures, her code of conduct, the various forms of beauty which her religious and social ideals assume Japan expresses her own personality, her *dharma,* which, in order to be of any worth, must be unique and at the same time represent Man of the Everlasting Life.

Lao-tze has said: ''Not knowing the eternal causes passions to rise; and that is evil''. He has also said: ''Let us die, and yet not perish''. For we die when we lose our physical life, we perish when we miss our humanity. And humanity is the *dharma* of human beings.

What is evident in this world is the endless procession of moving things; but what is to be realized, is the supreme human Truth by which the human world is permeated.

We must never forget to-day that a mere movement is not valuable in itself, that it may be a sign of a dangerous form of inertia. We must be reminded that a great upheaval of spirit, a universal realization of true dignity of man once caused by Buddha's teachings in India, started a movement for centuries which produced illumination of literature, art, science and numerous efforts of public beneficence. This was a movement whose motive force was not some additional accession of knowledge or power or urging of some overwhelming passion. It was an inspiration for freedom, the freedom which enables us to realize *dharma,* the truth of Eternal Man.

Lao-tze in one of his utterances has said: ''Those who have virtue *(dharma)* attend to their obligations; those who have no virtue attend to their claims.'' Progress which is not related to an inner *dharma,* but to an attraction which is external, seeks to satisfy our endless claims. But civilization, which is an ideal, gives us the abundant power to renounce which is the power that realizes the infinite and inspires creation.

This great Chinese sage has said: ''To increase life is called a blessing.'' For, the increase of life realizes the eternal life and yet does not transcend the limits of life's unity. The mountain pine grows tall and great, its every inch maintains the rhythm of an inner balance, and therefore even in its seeming extravagance it has the reticent grace of self-control. The tree and its productions belong to the same vital system of cadence; the timber, the flowers, leaves and fruits are one with the tree; their exuberance is not a malady of exaggeration, but a blessing.

Part Two

TECHNOLOGY AND THE PROFESSIONS

Part Four focuses on the relation between technology and the professions. Four major professions will be considered: agriculture, medicine, business, and engineering. It first must be emphasized that the relation of technology to these professions is an ancient one. Nothing could be further from the truth than the commonly held belief that the introduction of technology to these and other professions is relatively recent. Technology has been a part of our lives for a very long time. Early man who rubbed two sticks together to produce fire was already engaging in technological activity. So was the hunter with his club, his spear, and later, his bow and arrow. To emphasize the long-standing influence of technology on the professions, some prominent achievements of ancient times will be briefly discussed. But the major portion of this introduction will examine the current connections between technology and the four professions mentioned.

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One of the most outstanding technological achievements of ancient times was the construction of the Great Pyramid of Giza in Egypt. This pyramid is the tomb of King Khufu or Cheops, and was built for him around 2680 B.C. It contained secret passages and chambers, and originally rose to a height of 482 feet. The pyramid, considered one of the Seven Wonders of the Ancient World, covers thirteen acres and was built of approximately 2,300,000 huge limestone blocks, each weighing about two and a half tons. These extraordinarily heavy pieces were brought to the site of the pyramid and then lifted to their proper positions without the benefit of modern equipment. Today, as the Egyptian government prepares to restore the pyramid, which has suffered slow erosion during the past five thousand years, it will again employ the old methods using muscle and rope, rather than modern technology, which so far has not devised a crane that can cope with the shape of the pyramid.

The building of the Great Pyramid of Giza is fascinating because, among other things, it required sophisticated knowledge of two kinds of techniques. The first kind is best referred to as engineering "know-how," which includes the designing of the pyramid and its interior passages and chambers, as well as the devising of ways to execute the design. That the pyramid was designed and the plans executed with a precision that even modern engineers would be proud of is obvious from the detailed description offered by James Henry Breasted in his book *A History of Egypt*. According to Breasted, "some of the masonry finish is so fine that blocks weighing tons are set together with seams of considerable length, showing a joint of one ten-thousandth of an inch . . ."[1]

The second kind of technique that stands out in the building of the Great Pyramid is best described as organizational. The working force was arranged according to a certain hierarchy and a chain of command. This, combined with discipline and the assignment of specific tasks to each level of the hierarchy, created the first "megamachine" in history. Lewis Mumford finds this fact extremely significant because he sees in it the true beginnings of the Machine Age. The machine that was being introduced for the first time was a human machine. All its parts were human, and most were interchangeable. It was capable of generating thousands of horsepower, thus making the building of the pyramid possible without the help of sophisticated machinery. These impressive facts lead Mumford to argue that "this new kind of machine was far more complex than the contemporary potter's wheel or bow drill, and it remained the most advanced type of machine until the invention of the mechanical clock in the fourteenth century."[2]

The importance of this organizational achievement can hardly be overemphasized. Suffice it to say that for the modern economist John Kenneth Galbraith "modern economic society can only be understood as an effort, wholly successful, to synthesize by organization a group personality far superior *for its* purpose to a natural person . . ."[3] That is exactly what characterized the society which built the Great Pyramid of Giza. No one worker could even have begun to move a two-and-a-half-ton block of limestone, but a group armed with technology (as simple as it may have been) could, and in fact did. To emphasize further the parallel between the Egyptian and modern Western society, let us look at this additional passage from Galbraith:

> The real accomplishment of modern science and technology consists in taking ordinary men, informing them narrowly and deeply and then, through appropriate organization, arranging to have their knowledge combined with that of other specialized but equally ordinary men. This dispenses with the need for genius. The resulting performance, though less inspiring, is far more predictable. No individual genius arranged the flights to the moon. It was the work of organization—bureaucracy.[4]

Similarly, the pyramid was not the work of an individual genius. King, engineers, priests, overseers, and workers all contributed to the successful completion of the project. It was a colossal project designed and executed by an organization of ordinary men. Thus long before the age of modern science and technology, engineering and organizational techniques functioned to produce an impressive artifact.

Another interesting technological feat from ancient times is the construction of the Hanging Gardens of Babylon, which are also considered one of the Seven Wonders of the Ancient World. Although they have been destroyed, various writers have described them in detail.

The Hanging Gardens were built by Nebuchadnezzar, king of Babylon (reigned 605-562 B.C.). It is believed that they were built for his wife, a Median princess whose home was in the mountains of Persia. Babylon was flat and hot, and the princess had longed for the cool, green, and fresh surroundings of her native land, so Nebuchadnezzar set out to duplicate that environment as closely as possible. To that end he built an architectural wonder which crowned the roof of the imperial palace with masses of greenery layered in terraces to form hanging gardens.

But the Hanging Gardens were not Babylon's only claim to fame. Earlier, another of its kings, Hammurabi (reigned 1948-1905 B.C.), drew up the world's first code of law, which is of special interest to us because it contains the following laws relating to medical practice:

> If the doctor shall treat a gentleman and shall open an abscess with a bronze knife and shall preserve the eye of the patient, he shall receive ten shekels of silver.
>
> If the doctor shall open an abscess with a bronze knife and shall kill the patient or shall destroy the sight of the eye, his hands shall be cut off.[5]

These passages make clear the existence of medical technology in Babylon as early as the 1900's B.C.

Ancient Egypt also possessed a degree of medical technology. The Ebers Papyrus, written about 1500 B.C. and found in the tomb of Thebes in 1862 by Professor Ebers, contains approximately 900 prescriptions. More recently, the Edwin Smith Papyrus was translated. Its author was a surgeon who noted the role of the brain in controlling the lower limbs, and the role of the heart as the driving power of the human body. Surgical stitching is mentioned in this papyrus for the first time in medical literature.

What has been said of the ancient relation of technology to engineering and medicine can also be said of the relation of technology to agriculture, business, and economics. The wealth of Egypt, especially around the forty-third century B.C., came mainly from grain. Originally the Egyptians used the hoe for cultivating their fields. Then the plow, which utilizes animal power, was invented. This drastically increased the size of the cultivated areas, and was as significant an event in its time as the introduction of modern machinery to agriculture in the nineteenth and twentieth centuries A.D. With the subsequent increase in wealth, a more advanced tax system developed. Since no currency existed, taxes, loans, and business debts were made at first in grain. Later, copper rings were used as money. Those who did not pay their taxes were visited by official "tax collectors."

In the Tigris-Euphrates Valley, we find a similar development as early as the Kingdom of Sumer and Akkad, which preceded the rule of Nebuchadnezzar. The wealth of the area came mainly from barley and wheat. The inhabitants developed dikes, irrigation trenches, and other agricultural techniques to improve their harvest. They were also familiar with copper tools and utensils. During Babylonian times silver pieces came to be exchanged as money, and an enormous body of bookkeeping records was left behind in the form of hardened clay tablets.

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In ancient times the professions were closely tied to religious and magical beliefs, and this state of affairs persisted throughout the Middle Ages into the Renaissance and even later. As mentioned in the introduction to Part Two, professional activities took a secondary place to those of tending to the affairs of the soul. The consequences of such a situation were mixed. Earlier in this book it was argued that religious beliefs and their attendant values succeeded in keeping men's desires for power, possessions, and control within reasonable limits. It may be pointed out now that these beliefs also resulted in many events being regarded as the effects of supernatural causes; investigation of their real causes was thus inhibited. Diseases were often seen as a sign of divine punishment or as an act of possession by the devil. The story of ergot is an excellent example of this mode of reasoning. Leo Vining* informs us that in 857 A.D., according to German chroniclers of that period, the population around Duisberg was ravaged by "a great plague of swollen blisters that consumed the people by a loathsome rot so that their limbs were loosened and fell off before death." This horrible disease, it was much later discovered, was caused by grain contamination with ergot fungus. But people in the Middle Ages refered to it as the "holy fire." When the disease happened to cease at about the same time as a father kneeled before the bones of Saint Anthony, begging that his sick son be spared, the disease was renamed "Saint Anthony's fire." Such a mode of reasoning of course did not encourage the understanding of nature and its workings.

There were other religious beliefs that made scientific progress difficult. Since the body was regarded as the temple of the soul, it had derivative sanctity. Thus, it was not permissible to mutilate it in any way, even after death. Dissecting a corpse for the sake of medical knowledge was not acceptable, and many physicians throughout Europe had to rely on body snatchers to provide them with corpses for their anatomical research.

The story of Galileo, who was forced by the church to retract his pronouncements concerning the heliocentric theory of planetary motion, is widely known. The popular belief was that the earth was immobile and located at the center of the universe and that the other heavenly bodies rotated around it. This view supported the then common literal interpretation of the scriptures, which declared man the center of the universe. Galileo's theory, therefore, was difficult for laymen to believe, but more importantly, it was heretical, and he thus was forced to renounce it.

These and many other incidents, including the burning of witches, frustrated the rapid development of modern science and technology. Finally, however, with the accumulation of data, science and technology were secularized, ushering in the present era (for a more detailed discussion of this historical development, see the introduction to Part Two). In our present era of modern secularized science and technology, innovations are numerous, and the progress of human knowledge is astounding. However, secularized science and technology are encountering problems of their own. The rest of this introduction is devoted to a discussion of some of these problems.

A prefatory comment about this discussion is in order. With the modern alliance of science and technology, it has become possible to do things that man never dreamt of before. New devices are being invented daily. New sources of power are being tapped. Electric appliances, nuclear reactors, alloys, plastics, tractors, computers, kidney machines, brain scanners—all these and much more contribute in different ways to the hectic pace of development in the modern professions. To cope with this hectic pace as well as respond to modern demands for efficiency and profitability, it has become desirable to organize activities within these professions along corporate lines. This fact will be discussed in some detail later; suffice it to observe now that this new technique of organization combines professional goals with those of a successful business venture. As a result, a serious discussion of the professions in this introduction must address itself to this new technique of organization insofar as it has affected these professions and their traditional goals, practices, and values.

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As inventions multiply and new equipment proliferates in the various professions, an individual or a company must keep up or else fall behind through the use of outmoded techniques. Since with each invention new standards of efficiency and sophistication are set, relying on older techniques means less efficient operation. In farming, for example, to fail to keep up with new developments often means less produce and profit per acre than possible. In medicine, new equipment often makes the difference between life and death. In engineering, new techniques form a crucial base for further innovations. In business, the failure to keep up can make economic survival impossible. The constant updating of the professions becomes a need rather than a luxury.

But the cost of constant updating is quite high. Often a piece of equipment becomes obsolete within a year or two of its purchase, and the cost of replacement is continuously rising. For example, a tractor priced at $16,000 in 1974 costs almost twice as much today even though the new version, which may have a better door latch, is not more powerful. In 1896 an x-ray machine cost $50. Today, the more sophisticated and specialized CAT scanner combines x-ray equipment with a computer and a television cathode-ray tube. This diagnostic machine provides the physician with a cross-sectional view of the body and thus allows him to better detect various disorders. It is a great improvement over the old simple x-ray machine, but its current cost is about $700,000.

The effect of these spiraling costs on the professions is to make greater capital outlays necessary. The small farmer and the small businessman can no longer make it in today's world. The engineer must join a corporation, and the physician, whose own office equipment is becoming highly expensive, must count on the backup system of the hospitals in cases requiring more sophisticated equipment.

Increasing costs have thus translated themselves into size. "Bigger is better." A bigger corporation can better absorb a $700,000 bill for one piece of equipment than a single businessman. As a result all professions must organize along corporate lines in order to keep pace.

Even farming, which has traditionally been a small family enterprise, is now also moving in the direction of corporations. This trend has been prompted not only by the cost of machinery but also by the efficiency that the use of machinery demands. A tractor, for example, can work a bigger farm just as easily as a smaller one; and the more acres it works, the smaller the real cost of that tractor to the farmer. In a *Time* article on farming in the United States, Patrick Benedict, president and sole stockholder of Benedict Farms, Inc., argues that "if you're standing still you're really falling behind."[6] To ensure that he does not fall behind, he has continued for years to reinvest his profits and borrow additional money to acquire more land. He is also a firm believer in vertical integration—that is, owning operations related to farm products. He organized 1,600 farmers to raise $20 million, and borrowed another $47 million to buy out a sugar company that used to buy and process his and other farmers' sugar beets. He also teamed with nine other farmers to buy a $1.5 million grain elevator and incorporated it as Northern Grain Company. These two investments have allowed Mr. Benedict to move his farm products, whether for factory processing or sale, at the optimal time, giving him a better chance for increasing his profits.

High interest rates and the rising cost of land, machinery, fertilizers, fuel, and insecticides cut deeply into the farmer's profit. Consider, for example, the cost of fuel, which has increased rapidly for the farmer for two reasons: (1) the price of fuel has been escalating rapidly on the world market, and (2) the industrialization of agriculture has resulted in an increase in the amount of fuel needed to run a farm. Carol and John Steinhart* in "The Energy We Eat" provide us with some idea of how much more fuel is required by industrialized food production. They observe that while in primitive cultures, 5 to 50 calories of food were obtained in return for each calorie invested, industrialized food production requires the investment of 5 to 10 calories of fuel in order to obtain one calorie of food. This situation is regarded by the Steinharts as quite significant—especially if energy costs continue to increase, a highly likely prospect. They warn that it could result in famine in many areas of the world unless we return to less energy-intensive methods of food production.

Some distressing symptoms of the problems that lie ahead are already apparent. In February 1979, 3500 farmers in tractors and mobile homes converged on Washington to demand increased crop subsidies to offset the escalating costs of land, machinery, and fuel. In the summer of that same year, the farmers watched their fuel supplies dwindle as motorists competed for the limited quantities available.

These problems make the farmer's life difficult. For all his hard work Patrick Benedict averages a return of only three and a half percent on his $3.5 million investment. A bank certificate of deposit can return him around nine percent, without any effort. Such data discourages many young farmers and makes them go into other types of work. Even if they were able somehow to secure the needed capital to start a farm, the work is still hard and the returns small. The price of the corn in cornflakes rises from about $1.80 a bushel paid to the farmer to about $37 a bushel paid by the consumer to the grocer. Given the fact that farming is the single largest industry in the United States, according to U.S.D.A. statistics, current developments raise very serious issues concerning the national socioeconomic structure. Joe Flanagan, a farmer, complains in *Progressive Farmer:* "There is something wrong with the system when you trim and trim and trim your expenses, make a good crop, sell it for an above-average price, and still lose money."[7] Or make less profit than a bank's certificate of deposit can produce!

Frances Moore Lappé and Joseph Collins, who wrote *Food First: Beyond the Myth of Scarcity,* blame much of the malaise on agribusiness organizations. They claim that the same increasing concentration of control over land and marketing that directly causes hunger in underdeveloped countries is going on right here in the United States.[8] Let us pause momentarily to take a look at what is going on in the Third World. In *How the Other Half Dies,* Susan George points out that an average of eighty percent of the people in Asia live in the countryside, as do ninety-five percent of the people in some parts of Africa; most of these people are dependent on the land for their living.[9] Yet, she adds, "paradoxically, it is the very people who are living on the land who are not eating enough!"[10] She suggests that part of the explanation for this paradox is the fact that land ownership is a virtual monopoly of the wealthy and politically influential. The capital for farming this group's vast land holdings often comes from agribusiness corporations rooted in the United States. These corporations are interested in cash crops for export, not crops that would help alleviate hunger in the producing countries.[11] Thus while these countries produce, they do not feed their own hungry people. This seems to be a specific example of the kind of complaint raised by Denis Goulet* and Samir Amin.* When exported to other countries, technology (agricultural or otherwise) is used by corporations to serve their own interests, not the interests of the host country.

With this in mind we return to Lappé and Collins' claim that the same concentration of control over land and marketing is taking place in the United States. They produce the following astounding statistics:

> Five and one-half percent of agricultural corporations in the United States operates more than half of all land in farms.
>
> Almost 90% of vegetable production in the United States is controlled—either directly or through contracts—by major processing corporations.
>
> Less than 0.2% of all U.S. food manufacturers controls about 50% of the entire industry's assets.[12]

It is these same corporations, we are told, that are spreading their operations in the Third World.

Although these corporations do not necessarily pursue the same detrimental cash crop policy at home as abroad, their thorough vertical integration nevertheless does affect the situation at home. They can easily afford growing corn at about $1.80 a bushel, simply because they are the ones who make it into cornflakes and the ones who then sell it at the grocer's for about $37 a bushel. This is the great advantage of vertical integration. Patrick Benedict, a believer in vertical integration, bought a sugar factory with other farmers to help him market his sugar beet produce. But his grain, as far as we have been informed, remains essentially outside the process of vertical integration (despite his owning a grain elevator), as it does for most family farmers.

For the purchase of only two items—the sugar factory and the grain elevator—Mr. Benedict had to summon the financial powers of 1,609 farmers beside himself and borrow an additional $47 million to produce the necessary grand total of $68.5 million. Compare this figure with the staggering financial power of a single food corporation such as General Foods. Its total identifiable assets (as of March 1979) were about $2.5 billion. About one third of its assets are outside the United States, belonging to major subsidiaries in Europe, Canada, Mexico, Bermuda, Brazil, Venezuela, and the Phillipines. These assets include:

Land	$ 46,862,000
Buildings	424,758,000
Machinery and equipment	934,127,000

Advertising costs for General Foods in one year were $372,770,000.[13] Clearly, Mr. Benedict is a David fighting a Goliath.

The responsibility for this state of affairs must not be shifted automatically to technology. Indeed, as the next part of this discussion shows, the problem has different roots. For while it is true that technology breeds bigger and bigger organizations, it is not clear at all that the ethically and socially significant features of such organizations are necessitated by technology.

The major goal of a present-day corporation is to optimize its own profit. This goal determines the internal values of the organization and its subsequent behavior. For example, it is this goal which results in defining efficiency in terms of internal considerations alone without regard to effects on society (see Erich Fromm* on this subject). But this goal is not necessitated by technology. It is determined by considerations extraneous to technology or even to the imperatives of big organization. These considerations derive mainly from the prevalent ideology of society and its attendant values. In today's society, money is power.

Still, it is not the idea of profit that is being questioned here; rather, it is the idea of "profit no matter what." A strong case can be made for the introduction of new social values to contain the compulsive pursuit of profit, which in today's society is usually a manifestation of the unrestrained pursuit of power. Such social values would make obsolete incidents like those discussed by Leah Margulies* and by Eddy, Potter, and Page.*

Margulies argues that the Nestlé Company was aggressively marketing its powdered milk in Third World countries even as evidence of resulting malnutrition, illnesses, and death was mounting. As a solution to health problems created by doubtful business practices, she suggests continuous monitoring of corporate activity, cooperation among concerned health professionals, international agencies, and advocacy groups, and development of popular support for the view that business must be held accountable for unethical practices.

Eddy, Potter, and Page discuss the DC-10 aircraft. They contend that many persons, including officials of the Federal Aviation Administration, were aware of design defects in the aircraft but that these defects were not corrected by the builder, McDonnell Douglas, until a Turkish Airlines DC-10 crashed near Paris in 1974, killing 346 persons. When another DC-10 crash occurred—near Chicago's O'Hare International Airport in June 1979, killing 275 persons—the FAA grounded the aircraft. The grounding order declared, according to *Time*, that the engine-and-pylon assembly "may not be of proper design, material, specification, construction and performance for safe operation."[14] Nevertheless, the grounding order was lifted within days amid reports of severe financial losses—about $5 million a day to airlines using the DC-10. If the loss of revenue indeed played a part in the FAA decision to lift the grounding order, one must question the political-economic organization of our society, which risks lives to save a company from bankruptcy.

An even more stunning incident is that of Three Mile Island. In April 1979, the first widely-known nuclear accident took place—in Pennsylvania, at the Three Mile Island nuclear power plant operated by Metropolitan Edison Company. The accident, which threatened at one point to produce the worst possible situation, a core melt-down, caused the plant to shut down. As antinuclear sentiment spread, all similar plants around the nation were shut down also. The accident was charged to human error, but a plant engineer interviewed by *Time* had more to say on this topic. According to him, Unit 2, the site of the accident, had been plagued with problems during the shakedown phase. These problems, though not serious, did indicate a need for a thorough investigation of the cause of the malfunctions. Yet, instead of conducting such an investigation, Metropolitan Edison soon commenced commercial operation of the unit.[15]

Time points out that the unit was pressed into service on December 30, 1978, and that by meeting the year-end deadline, Metropolitan Edison qualified for $17 million to $28 million in 1978 tax investment credits, plus $20 million in depreciation deductions.[16] Thus as David Barasch, attorney for Pennsylvania's State Consumer Advocate Office, noted, "There was no question that there was strong incentive for the company to get that plant on line fast.''[17]

The methods by which Metropolitan Edison attempted to reduce its losses after the incident caused outraged protests among its consumers. Replacing the electricity from its shutdown plant was costing the company about $1 million a day. To recover part of its losses, it announced that it had no alternative but to raise monthly rates by $7.50. Angry consumers could not see why they should pay for the company's mistakes.

In late August 1979, the President's commission investigating the Three Mile Island accident was preparing its recommendations. It had already uncovered ''evidence of faulty design and lax procedures in the operations of nuclear power plants,'' as well as earlier nuclear-plant mishaps elsewhere.[18] As the commission prepared to question Harold R. Denton, the Nuclear Regulatory Commission's chief of reactor regulation, it discovered that Denton had moved to lift a three-month freeze on the licensing of new reactors. Members of the commission were outraged. Arizona Governor Bruce Babbit protested that the licensing decision implied ''a judgement that the system is basically sound and that we ought to proceed with nuclear development.''[19] Another member of the commission, Anna Trunk, who lives near Three Mile Island, asked Denton, ''Could you give me one good reason why I should trust you or the NRC?''[20]

This question hints at even deeper anxieties relating to technological decisions. Of course, we more commonly ask: ''Is nuclear energy safe?'' But there are people who do not care at all about the answer to this question because they reject the use of nuclear energy, even if it were safe. The reason for their opposition stems from ideological considerations. One may say that it is not nuclear technology *per se* that they are opposed to, but rather nuclear technology in the hands of those whose ideology is seen as founded upon an unrestrained Will-to-Power (for more on the Will-to-Power, see the introduction to Part Two).

The basis for such opposition becomes clear if we examine the views of proponents of nuclear energy. For example, Jean-Claud Leny, executive director of Framatone, a company in charge of operating pressurized water reactors, argues that nuclear plants are not dangerous if they are run by competent, and presumably centralized, staff rather than being entrusted to local groups who may or may not be capable of handling the task. He states that ''in my opinion it is essential that few nuclear plants be constructed . . . and [that they be] controlled in a quasi-military way.''[21]

The possibility of a quasi-military organization of nuclear plants is regarded by opponents of nuclear energy as a very disturbing possibility whose significance extends beyond these plants to society as a whole. André Gorz, editor of *Les Temps Modernes,* warns that ''nuclear society assumes the creation of a caste of militarized technicians, obedient like a medieval knighthood, with its own code and its own internal hierarchy, which would be exempt from the common law and invested with extensive powers of control, surveillance, and regulation.''[22] He further cautions that corporations with such technology at their disposal not only will control our society, but will be capable collectively of extending their hegemony over the whole planet.

Therefore, Gorz's rejection of nuclear energy is founded upon his rejection of hegemony and the centralization of power in the hands of corporations which he regards as power-hungry and thus not trustworthy. For Gorz, nuclear energy questions translate primarily not into issues of safety but rather into political and ideological issues concerning democracy.

Harold Ketterer and John R. Schmidhauser* echo these concerns. They argue that a handful of dominant corporations is on its way to controlling nuclear fuel, a major alternative source of energy in the United States. Ketterer and Schmidhauser regard this situation as grave. To underline its gravity they quote former Senator Aiken, who warns that ''when you control energy . . . then you control the nation . . . a very serious threat to political democracy.''

Thus any attempt to defend nuclear energy as clean, efficient, and safe misses the main objections of the anti–nuclear energy groups that are concerned with democracy. These groups regard the political, social, and human rights of the individual as far more important than his material luxury.

One hotly debated issue in business and government circles today ties in directly with these considerations. Many businesses and government officials have questioned the advisability of the transfer of technology from the United States to other countries. In *Foreign Policy* Jack Baranson complains, in ''Technology Exports Can Hurt Us,'' that U.S. corporations have redefined their ''self-interest'' in such a way as to permit the sale of their sophisticated technological products to noncontrolled foreign enterprises.[23] The problem with such sales is that they sometimes implant in the foreign countries a competitive productive capability. For example, Amdahl corporation, founded by a former IBM engineer, transferred computer technology to Fujitsu Ltd. in Japan in return for successive rounds of finance capital. Now, eighty percent of Amdahl computer manufacturing requirements are based at Fujitsu.

Another example comes from Algeria. In 1972, General Telephone and Electronics signed a $233 million contract to build an electronics plant. Under the agreement Algerian technicians and managers were being trained in the United States and were expected to be capable of managing their entire Sidi-Bel Abbes facility within a few years of the initiation of their training.

Baranson is displeased with such cases of technology transfer. He is concerned that by exporting technology and increasing the technological knowledge of other countries, ''U.S. firms may contribute to both the deterioration of the U.S. trade balance and to the loss of U.S. technical leadership.''[24] So he urges that in deciding what sort of technology may be exported by the United States, a distinction be drawn between relatively innocuous transfers of technology easily available from other sources in the world and the transfer of sophisticated technology obtainable only in the United States through specific companies. He also urges that a distinction be drawn between technological exports that implant a certain advanced technology in the importing country, and those that do not.

What emerges from Baranson's article is an overriding concern for the loss of overseas profit and control of international markets. The global political and economic effects of pursuing a policy of denying technological know-how to other countries, as a way of protecting overseas profits and maintaining politico-economic control, is discussed by various authors in this book. Daniel Bell* and Zbiginew Brzezinski* are especially vocal about the dangers of technological monopoly to the political stability of the world as a whole. Daniel Bell observes, in ''The Future World Disorder,'' that ''the real time bomb in international economic relations is that of industrialization.'' He adds that effective international means must be designed to achieve a new, more equitable international division of labor—one that can provide economic and perhaps political stability for the world. International agencies could hasten the birth of such a new order by offering technological aid to developing nations.

In ''America in the Technetronic Age,'' Brzezinski voices concerns similar to Bell's. His assessment of potential global political instability leads him to conclude that ''international co-operation will be necessary in almost every facet of life'' and to suggest ''making the massive diffusion of scientific-technological knowledge a principle focus of American involvement in world affairs.'' Thus, if Bell and Brzezinski had their way, the ideology of unrestrained control would be tempered by the new realities emerging on the international scene.

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So far, this introduction has placed special emphasis on the economic and political aspects of the impact of technology on the professions. But clearly the farmer's plight, the power of corporations, and the development of nuclear technology all have social and ethical implications as well. So the rest of this discussion will emphasize these other considerations by focusing on the controversy surrounding recombinant DNA research. For this controversy provides an excellent example of the ethical and social dilemmas facing today's scientists and technologists.

Some introductory remarks about recombinant DNA research may be helpful at this point. DNA (deoxyribonucleic acid) is the primary genetic material in cells—whether human, animal, or plant. Each DNA molecule is usually a long two-stranded chain that looks like a "double helix." Its chemical and physical properties make it ideal for replication and transfer of information. Indeed, a DNA molecule usually contains a large number of the hereditary units called genes. Thus one of the chief roles of DNA is the transmission of hereditary characteristics, while a related role is the regulation of enzyme synthesis in the cell.

An important point in the development of genetic research was reached when scientists developed techniques by which they could combine a DNA segment from one organism with a DNA segment from another. The resulting DNA strand contained a genetic code which was a composite of the genetic codes contained in the two parent DNA segments. These recombinant DNA techniques made possible the generation of organisms hitherto unknown on earth. The natural barrier that had thus far restricted the genetic combination of different species was surmounted.

Recombinant DNA techniques, then, are techniques by which genes from one organism are spliced to genes of another. These techniques have various applications and consequences. One of the more valuable applications is the creation of an insulin-producing bacterium, which was developed by splicing genes of a host bacterium to human genes having the code appropriate for the synthesis of insulin. As a result, the modified insulin-producing bacterium is an "insulin factory," and when it replicates itself it produces more insulin factories. This achievement has been highly beneficial in the treatment of diabetics, who have had so far to rely on insulin produced by cows and pigs. The new hybrid bacterium produces human insulin, which is far superior because it has a much lower rejection rate among diabetics.

Many scientists are understandably enthusiastic about recombinant DNA research. Molecular biologist Stanley Cohen,* from Stanford University School of Medicine, provides some reasons for his enthusiasm. He explains that within a short period of time the use of recombinant DNA technology has already substantially improved our fundamental knowledge of living organisms. Among other things, it has provided us with a great deal of information concerning the structure, propagation, and gene regulation of some of these organisms. Such knowledge is useful in understanding genetic defects that are the causes of various serious disorders.

Recombinant DNA research has become part of "the high-technology of medicine," defined by Lewis Thomas* as that technology which is based on a genuine understanding of the mechanisms of disease. As such, this technology is not a stopgap measure in the face of incapacitating illnesses, rather, it attempts to cure, if not eradicate, disease altogether. Recently, it was announced that one type of cancer had been traced to a genetic defect in the kidney. Through recombinant DNA research such a defect may become correctable in the future, thus preempting half-way technologies used for kidney cancer victims, such as surgery. Other diseases resulting from genetic defects or disorders seem to be equally accessible to cure—for example, Tay-Sachs disease, cardiovascular disease, diabetes, and hemophilia.

Furthermore, recombinant DNA research promises to provide us with extensive control over various aspects of our lives, and to make possible new sets of choices. Biologist Robert Sinsheimer, at the California Institute of Technology in Pasadena, discusses these prospects in the following passage:

> Would you like to control the sex of your offspring? It will be as you wish. Would you like your son to be six feet tall—seven feet? Eight feet? What troubles you?—allergy, obesity, arthritic pain? These will be easily handled. For cancer, diabetes, phenylketonuria (a metabolic disease) there will be genetic therapy. The appropriate DNA will be provided in the appropriate dose. Viral and microbial disease will be easily met. Even the timeless patterns of growth and maturity and aging will be subject to our design.[25]

But Amatai Etzioni* points out that the ability to control the sex of one's offspring is not without its social repercussions. For example, girls in many cultures are a liability; thus if parents were given a choice in the matter, the result could be a sexual imbalance in society, which could lead ultimately to social dislocations. Similarly, the ability to extend the human life span is not without its social repercussions. Such an ability could ultimately force us to drastically alter our concepts of education, marriage, and reproduction, among others.

Thus, although recombinant DNA research is an extremely exciting field of research, it has the potential of creating enormous ethical and social problems. But this is hardly the most disconcerting aspect of such research. Recently, some scientists have been experimenting with the recombination of genes carrying antibiotic resistance, and with the recombination of genes with oncogenic (that is, cancer-causing) viruses. If any of the hybrid genes were to escape the confines of the laboratory, the effect on the community, and perhaps the nation and the world, could be disastrous.

These fears have spurred an extensive debate in the scientific community concerning the risks involved in recombinant DNA research. In April 1974, a special committee of scientists, chosen by the National Academy of Sciences to evaluate such risks, asked all scientists to honor a temporary moratorium on certain types of potentially dangerous research until the committee had time to assess the situation. The scientists agreed. After several meetings and a major international conference in Asilomar, California, the moratorium was finally ended and some voluntary guidelines for recombinant DNA research were suggested. In July 1976 the National Institutes of Health provided a mandatory set of guidelines for scientists receiving federal funding for such research.

Still, these measures have not succeeded in ending the heated debate among scientists on the risks of recombinant DNA research. Many continue to doubt the wisdom of tinkering with new forms of life in laboratories. Retired Columbia biochemist Erwin Chargaff* asks, "Have we the right to counteract, irreversibly, the evolutionary wisdom of millions of years in order to satisfy the ambition and curiosity of a few scientists?" But Stanley Cohen retorts by reminding Chargaff that this same evolutionary wisdom provided the gene combinations for bubonic plague, small pox, typhoid, polio, diabetes, cancer, and many other diseases that have caused the suffering and death of millions. Clearly, for Cohen, if recombinant DNA is to be opposed, such opposition must rest on something other than the appeal to evolutionary wisdom.

A closer look at Chargaff's position reveals that Chargaff is not opposed in principle to recombinant DNA research. Rather, he is appalled by the apparent haste exhibited by scientists who experiment with the genetic material before fully understanding various features of DNA. He points out that the significance of spacer regions and repetitive sequences in DNA structures is still unknown, and he expresses concern that many of the experiments are being performed without a full appreciation of what is going on. Chargaff worries that such haste in experimentation may result in the introduction of a form of life which is damaging to humans while at the same time resistant to attempts aimed at controlling or destroying it. He warns, "You can stop splitting the atom; you can stop visiting the moon . . . But you cannot recall a new form of life."

The similarity between this debate and the debate between the ecologists and their adversaries (see the introduction to Part Two, as well as the article by William Tucker*) is striking.

So it is not surprising that Chargaff has received support for his position from the ecologists. Francine Robinson Simbring, of the Committee for Genetics, organized by Friends of the Earth (a group of ecologists), argues that there are clear parallels between the recombinant DNA controversy and the nuclear energy controversy.[26] In both cases, Simbring claims, the proponents of the research have defined the problems associated with the research narrowly, and then addressed themselves to these problems, ignoring the other, unquantifiable, ones. In the case of nuclear energy, attention has centered on design criteria, reactor safety, and regulation when it should also have centered on the genetic risk to future generations, human fallibility, and the vulnerability of centralized electric generation, to mention only a few other major problems. Similarly, in the case of recombinant DNA research, attention is focusing now on laboratory containment as the pivotal problem. However, there are other pressing problems to be addressed, and such a narrow definition of the problems at hand must be rejected. Simbring concludes:

> It is therefore essential that open discussion include the entire range of problems in the field of genetic engineering and take into account the biohazards of accidental release of uncontrollable new organisms, the implications of interference with evolution, reduction of diversity in the gene pool, the imposition of complex medical decisions on individuals and society, and the inherent fallibility (not to mention corruptibility) of inspection, enforcement, and regulatory bodies.[27]

What complicates matters is that a new DNA industry has mushroomed. Various corporations, including Standard Oil of Indiana and National Distillers Corporation, have invested about $150 million in recombinant DNA research. Cetus Corporation is engineering a bug to make alcohol from manioc, a starchy vegetable. Such research is expected to yield astronomical profits. Ronald Cape, chairman of Cetus, says "we are talking about billion-dollar possibilities."[28] Given the high stakes, corporations are reportedly exercising an increasing amount of control over the research they fund at various academic institutions.

This new situation has disturbed many scientists and fueled the controversy further. Jonathan King, a biologist at the Massachusetts Institute of Technology, warns that corporations are using their research scientists as front men who claim interest in the expansion of knowledge. The true motives of the corporation, King argues, are pecuniary: "A fortune is going to be made from the cloning of insulin in bacteria . . . They are not going to sell that insulin cheap . . . because it's human insulin. [But] they are going to *produce* it cheap. That is a very, very powerful force behind the scenes . . ."[29]

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Clearly, technology has deeply permeated the professions, giving rise both to outstanding achievements and to complicated problems. In the process, it has left its mark on every aspect of our individual and social existence.

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Technology and agriculture

The energy we eat

CAROL and JOHN STEINHART

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Food remains the most basic human need. In this selection from the Steinharts' book Energy: Sources, Use and Role in Human Affairs, *a thorough, energy-oriented analysis of the food system in the United States is developed. Some startling facts—unnoticeable in a conventional economic analysis—are revealed. "In primitive cultures, 5 to 50 calories of food were obtained for each calorie invested. Some highly civilized cultures have done as well and occasionally better. In sharp contrast, industrialized food production requires an input of 5 to 10 calories of fuel to obtain 1 calorie of food." This situation presents a problem immediately. Given the imminent energy shortages, how can the United States reduce its energy expenditures in agriculture and the food system as a whole? The Steinharts suggest several ways of achieving that end.*

The kind of energy that has always been of first importance is food. Throughout most of human history, man has relied on his own labor to provide food. If the energy value of the food obtained had not substantially exceeded the energy expended in obtaining it, our species would not have survived.

Through the development of agriculture, man was able to manipulate the flow of energy in various ecosystems in order to divert an increasingly large fraction of the earth's productivity to his own use. He did this by simplifying the complex natural ecosystem—by decreasing the number of species in the system and by controlling the species that competed with him for the yield. Maintenance of the simplified system required an endless input of energy. At first this was restricted to manpower, as techniques for preparing the soil, planting, weeding, driving off pests, and harvesting were developed. Later, animal power was exploited. Still later, inanimate energy from wind and water was put to work, and finally, energy from the fossil fuels was utilized in food production.

In many parts of the world, agriculture still depends on energy from people, animals, and the sun. If conditions are favorable, such solar agriculture can give very high yields—for example, in wet rice culture, up to 50 calories are returned in harvest for every calorie of human energy investment. Modern agriculture, however, depends on converting fossil fuels into meat and potatoes, and there is an increasingly unfavorable ratio of energy input to food output. It is due to large-scale energy subsidy that agricultural yields have increased manyfold in the United States during this century. In 1900, a single farmer could feed about five people. By 1940 he could feed 10 and in 1960 he could feed 25. Today, the labor of one farmer feeds nearly 50 people, owing to the development of new fungicides, herbicides, rodenticides, insecticides, miticides, nematocides, antibiotics, vaccines, fertilizers, equipment, and specialized varieties of plants and animals. But it is not just one farmer who feeds 50 people. It is one

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farmer, many tons of coal, many barrels of oil, and an immense food processing and distribution system. In this chapter we will see how the present situation has come about.

ENERGY IN ECOSYSTEMS

Life can be viewed as a ceaseless web of energy conversions which follow well-known principles of energy conservation and transformation. Many ecologists describe an ecosystem in terms of the energy that flows into and out of it and from one trophic level to another (that is, from green plants to herbivores to carnivores or from any of these levels to decomposers). The tropical rain forest is an example of a complex ecosystem characterized by a large mass of living organisms and efficient use of available energy. In the rain forest there are many hundreds of species of plants, each specialized in its structure and function to fill a unique niche, and each accompanied by its cadre of insect predators specialized to deal with it. Armies of microorganisms live in association with roots, soil, and dead matter. Fungus-eating flies, beetles, termites, and other small animals feed on the microorganisms. They in turn are eaten by a variety of amphibians and reptiles. Birds and mammals feed on everything, including each other. Man, the most relentless and least specialized predator of all, is the one creature likely to upset the balance.

A great deal of energy is expended in maintaining the integrity of such a system. In the rain forest, energy flows through an intricate network of feedback loops that regulate all the interrelationships among species. Epidemics are virtually impossible because of the low density of any particular population. If one species increases, others usually increase to counteract it until order is restored. Similarly, should a species decline, its predators also decline or shift their attention to an alternative food source until decreased predation permits recovery of the original population. Even if one species should disappear, the system survives because there are many alternative pathways along which energy and materials can flow. Diversity of species insures that nutrients will be cycled effectively and soil structure preserved.

This complex, stable natural system supports the highest productivity and the greatest mass of living organisms possible under prevailing climatic conditions. Man can glean very little from this system, however, for little remains after respiration, predators, parasites, and decomposers claim their share. The situation in a rain forest is in sharp contrast to that in a field of grass. Energy is stored in a field of grass: it is used primarily for growth, rather than for maintaining the structure of the system. But a field of grass generally lacks stability because it contains relatively few species and few feedback loops which regulate interactions among species. Many ecological niches are empty, inviting other species to invade. Under many conditions, the short-lived, rapidly growing, prolific species in the open field tend eventually to be displaced by a succession of slower growing, longer lived, less prolific species until a system develops which is relatively stable under the prevailing conditions of soil and climate. Left undisturbed, a meadow usually becomes a forest.

The achievement of agriculture is to simplify the system so that, as in a field of grass, the maximum amount of solar energy is channeled into growth. Man supplies the energy for maintenance. He plows and plants. He fights off competitors, predators, and disease. He supplies fertilizer to replace losses from harvesting. He shelters his animals, feeds and vaccinates them, and helps them to breed and to bear and raise their young. Thus, only through a steady input of energy is man able to divert most of the productivity of his fields to his own ends.

It is a difficult struggle to maintain the simplified system however much energy is put into it. Where fields lie barren for part of the year, erosion and deterioration of soil structure claim their toll. Bigger and better pests continually appear. Where irrigation is practiced, water shortages and increasing salinity haunt the farmer. And if a wheat field is abandoned, does a crop of wheat come up the next year? Of course not. This illustrates a major difference between wild plants and the plants that are adapted to modern agricultural methods. Wild plants are hardy, physiologically adaptable, and able to withstand adversity. Man's crops are highly specialized for growth, and consequently they are dependent on man for protection and even their own propagation.

THE PENALTY FOR IMPROVEMENT

The success of modern agriculture depends in part on the development of fast growing, high yielding strains of plants and animals, whose productivity in turn depends on energy-intensive agriculture. For more than ten thousand years man has engaged in selective breeding of domestic plants and animals. One of the most remarkable stories is that of maize, or corn. The first evidence of wild maize is from Mexico, dating from more than 7000 years ago. The plant probably looked similar to any other grass that grows in meadows, and the ear was no larger than your thumbnail. Lurking in the small seed, however, was the potential to become the corn of today, with huge ears of closely packed grain. The yield of modern hybrid corn is more than 90 bushels per acre in the midwestern United States. But corn can no longer survive without man. Even if it weathered a dry season on poor soil, escaping disease and predation, it would perish within a generation or two, for it can no longer shed its seed to propagate itself.

Other domestic plants and animals have also become increasingly dependent on man for their survival. It seems that an organism can be either a generalist or a specialist, but not both. An organism can process just so much energy in its lifetime. If this energy is channeled largely into growth, man must tend to the other needs of the organism. Our improved plants and animals are not truly improved, but are merely specialized. They are specialized in growing wool, fat roots, or giant fruits, in laying eggs or making milk. In diverting their energy into rapid growth, they sacrifice many qualities that allowed their wild forebears to survive. Selective breeding may solve specific problems, but we are fooling ourselves when we expect a plant to resist disease, discourage predators and competitors, withstand unfavorable climatic and nutritional conditions, grow rapidly, reproduce abundantly, and still yield a bountiful harvest that is tasty, nutritious, and beautiful. One manifestation of the penalty for improvement is that, in the plant world, favorite varieties of grapes, roses, and citrus, to name a few, are routinely grafted onto wild rootstocks to increase their vigor.

Another feature of modern crop plants and domestic animals is genetic uniformity. Just as species diversity enhances a natural system's chances for survival, genetic diversity enhances a species' chances. If misfortune befalls a genetic subset of a group, the remaining members can avert disaster for the population as a whole. In addition to being specialized for growth of one sort or another, domestic plants and animals also tend toward genetic uniformity, which implies uniform resistance or susceptibility to adversity. Through modern practices in animal breeding, a dairy bull can spread his genes around the world before some camouflaged weakness makes itself known in his offspring. Vegetative propagation of plants and other common practices insure dependably uniform crops down to the end. For a popular variety of potato known as the lumper, the end was the Irish potato famine of 1846.

It is contradictory to desire uniformity and diversity at the same time. Modern agriculture values uniformity above all else. The risks are well known, but the benefits seem worth the gamble. As a result, there have been some disastrous epidemics in our country, including southern leaf blight of corn, fungus disease of a popular strain of oats called Victory, and the wildfire spread of a virulent new race of wheat stem rust which attacked a variety of wheat bred for resistance to the old race of wheat stem rust. The problem of plant breeders is that while they make hundreds of experimental crosses, nature tries millions. One mutant fungus spore or one fecund insect can undo years of the work of man.

The high-yielding varieties of grain that are being spread throughout the world as the green revolution represent the most extensive experiment in uniformity of crops yet tried. When things go well with the green revolution they go very well indeed; but the miracle grains are susceptible to widespread disaster and they produce no miracles unless grown under the most favorable conditions. But complex as are the problems of the green revolution, ther alternative seems to be starvation for about a billion people.

LAND RESOURCES AND AGRICULTURE

There are three ways in which we can try to feed the growing number of human beings on earth: open up new agricultural and grazing lands, increase the productivity of the lands already in use, and develop new sources of food. The long-term success of any of these depends on the size of the population we are trying to support and on our ability to design self-sustaining systems for which there is a non-depletable source of energy and in which materials are recycled.

We are familiar enough with the surface of our planet to know that no hidden paradise remains to be discovered. The area of the earth's ice-free land surface is about 32 billion acres. Roughly one quarter of this is potentially arable, another quarter is potentially grazable, and half is useless for agriculture, although some of it is forested. Much of the unused potentially arable land is in the tropics, where its potential may be more theoretical than practical. It certainly is not farmable with today's knowledge and techniques and economic restrictions. Practically all the land that can be cultivated under existing social and economic conditions is already under cultivation.

In North America, large amounts of arable land are not being farmed. However, we should not be optimistic about possibilities for expansion, for the best land is already cultivated and what remains has serious deficiencies. Furthermore, buildings and highways are spreading so malignantly over so much of our prime farmland that projections for California, for example, indicate that in less than 50 years half of the state's agricultural land will have been converted into nonagricultural uses. It is doubtful that, in opening new lands, we can run fast enough to stay where we are.

There are sound reasons for not rushing to open up vast new areas for crops or grazing, even if technical and economic obstacles could be overcome. One reason is that agriculture, especially as practiced in industrialized nations, depends on the activities of unmanaged ecosystems for the cycling of wastes and other materials. The capacities of some of these systems are already overtaxed, and further reduction in their size would intensify the problems. Another is that biologists emphasize the importance of maintaining reservoirs of wild plants and animals from which new and valuable domesticates may be developed. In general, the best plan seems to be to increase the productivity of lands already under cultivation, which inevitably requires an energy subsidy. The rest of this chapter analyzes the energy intensive food system in the United States and questions the extent to which it is desirable or even possible to transfer this technology to the developing nations.

ENERGY USE IN AN INDUSTRIAL FOOD SYSTEM

In a modern industrial society, only a tiny fraction of the population is in frequent contact with the soil, and an even smaller fraction of the population raises food on the soil. The proportion of the population engaged in farming halved between 1920 and 1950, and then halved again by 1962. Now it has almost halved again and yet a majority of the remaining farmers hold part-time jobs off the farm.[1] Simultaneously, work animals declined from a peak of more than 22 million in 1920 to very small numbers at present.[2]

In economic terms, the value of food as a portion of the total goods and services of society now amounts to a smaller fraction of the gross national product than it once did. Energy inputs to farming have increased enormously since 1920,[3] and the apparent decrease in farm labor is offset in part by the growth of support industries for the farmer. But with these changes on the farm have come a variety of other changes in the U.S. food system, many of which are now deeply embedded in the fabric of daily life. In the past fifty years, canned, frozen and other processed foods have become principal items in our diet. At present the food processing industry is the fourth largest energy consumer in the Standard Industrial Classification groupings. The use of transportation in the food system has grown apace, and the proliferation of appliances in both numbers and complexity still continues in homes, institutions, and stores. Hardly anyone eats much food as it comes from the fields. Even farmers purchase most of their food from markets in town.

Present energy supply problems make this growth of energy use in the food system worth investigating. It is the purpose of this chapter to do so. But there are larger matters at stake. Georgescu-Roegen notes that "the evidence now before us—of a world which can produce automobiles, television sets, etc., at a greater speed than the increase in population, but is simultaneously menaced by mass starvation—is disturbing."[1] In the search for a solution to the world's food problems, the common attempt to transplant a small piece of a highly industrialized food system to the hungry nations of the world is plausible enough, but so far the outcome is unclear. Perhaps an examination of the energy flow in the U.S. food system as it has been developed can provide some insights that are not available from the usual economic measures.

Measures of food systems

Descriptions of agricultural systems are given most often in economic terms. A wealth of statistics is collected in the United States and in most other countries indicating production amounts, shipments, income, labor, expenses and dollar flow in the agricultural sector of the economy. In what follows, we will make use of these statistics, for these values are of considerable use in determining the economic position of farmers in our society. But agricultural statistics are only a tiny fraction of the story.

Energy flow is another measure available to gauge societies and nations. Only after some nations shifted large portions of the population to manufacturing, specialized tasks, and mechanized food production, and shifted the prime sources of energy to fuels that were transportable and usable for a wide variety of activities could energy flow be a measure of a society's activities. Today it is only in one-fifth of the world that these conditions are sufficiently advanced.

What we would like to know is: how does our food supply system compare in terms of energy use to other societies, and to our own past. Perhaps, knowing this, we can estimate the value of energy flow measures as an adjunct to, but different from, economic measures.

Energy in the United States food system

In the morning, breakfast offers orange juice from Florida by way of the Minute Maid factory, bacon from a midwestern meat packer, cereal from Nebraska and General Mills, eggs from California, milk from not too far away, and coffee from Colombia. All these things are available at the local supermarket (4.7 miles each way in a 300 h.p. automobile), stored in a refrigerator-freezer and cooked on an instant-on gas stove (see appendix D).

The present food system in the United States is complex and the attempt to analyze it in terms of energy use will introduce questions far more perplexing than would the same analysis performed on simpler societies. Such an analysis is worthwhile, however, if only to find out where we stand. We have a food system and most of us get enough to eat from it. If, in addition, one considers the food supply problems, present and future, of societies where a smaller fraction of the people get enough to eat, then our experience with an industrialized food system is even more important. There is simply no gainsaying the fact that most nations are trying to acquire industrialized food systems of their own, whether in whole or in part.

What economics tells us is that food in the United States is expensive by world standards. In 1970 the average annual per capita expenditure for food in the United States was about $600.[3] This is larger than the per capita gross domestic product in more than 30 nations of the world. These 30 nations contain most of the world's people and a vast majority of those who are underfed. It would be convenient to know whether we can put our hands into the workings of our own industrialized food system to extract a piece of it that might mitigate their plight, or whether they must become equally industrialized in order to operate such a food supply system. Even if we consider the diet of a poor resident of India, the annual cost of his food at U.S. prices would be about $200—more than twice his annual income.

The analysis of energy use in the food system begins with an omission. We will neglect that crucial input of energy provided by the sun to the plants upon which the entire food supply depends. Photosynthesis is about 1 percent efficient; thus the maximum solar radiation captured by plants is about 5×10^3 kcal/m^2 per year. Ultimately we can compare the solar input with the energy subsidy supplied by modern technology.

Seven categories of energy use on the farm were considered. The amounts of energy used are shown in [Figure 1]. The values for farm machinery and tractors are for the manufacture of new units only and do not include parts and maintenance for existing units. The amounts shown for direct fuel use and electricity consumption are a bit too high because they include some residential uses of the farmer and his family. On the other hand, some uses in these categories are not reported in the summaries employed to obtain the values for direct fuel and electricity usage. These and similar problems are discussed in the appendix. Note the relatively high energy cost associated with irrigation. In the United States, less than 5 percent of the cropland is irrigated. In some countries where the green revolution is being attempted, the new high yield varieties require irrigation while native crops did not. If that were the case in the United States, irrigation would be the largest single use of energy on the farm.

Little food makes its way from field and farm directly to the table. The vast complex of processing, packaging, and transport has been grouped together in a second major subdivision of the food system. [Figure 2] displays the energy use in food processing and packaging. Energy use for transport of food should be charged to the farm in part, but we have not done so because the calculation of the energy

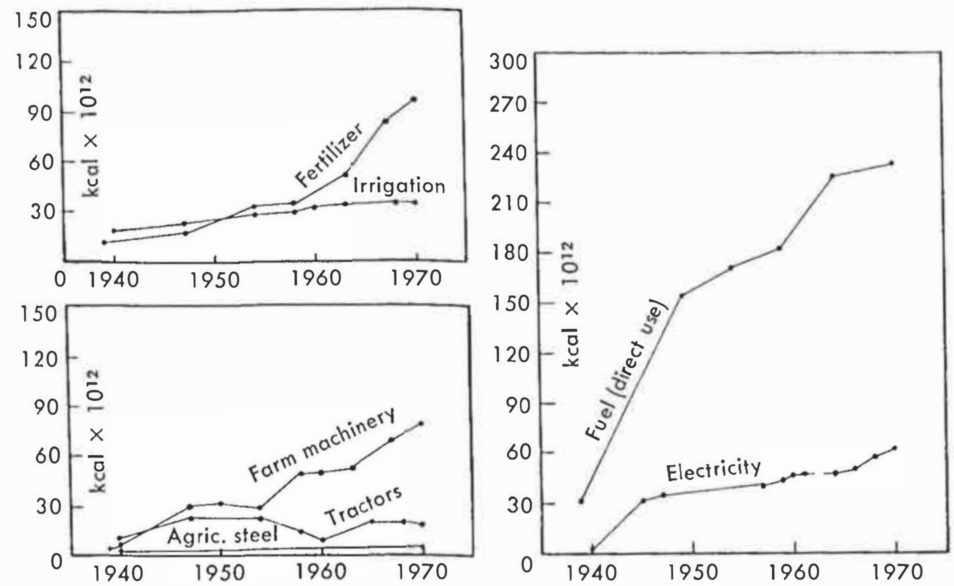


Fig. 1. Energy use on farms, 1940-1970. Transportation is included in the food processing sector.

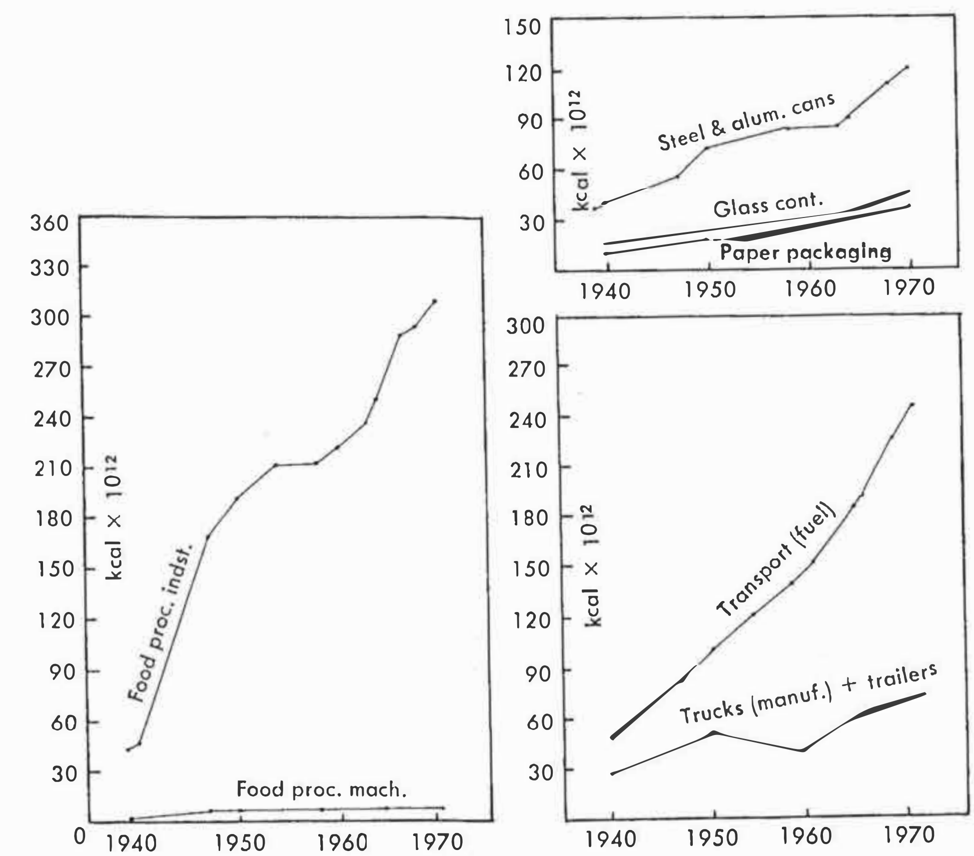


Fig. 2. Energy use in the food processing sector.

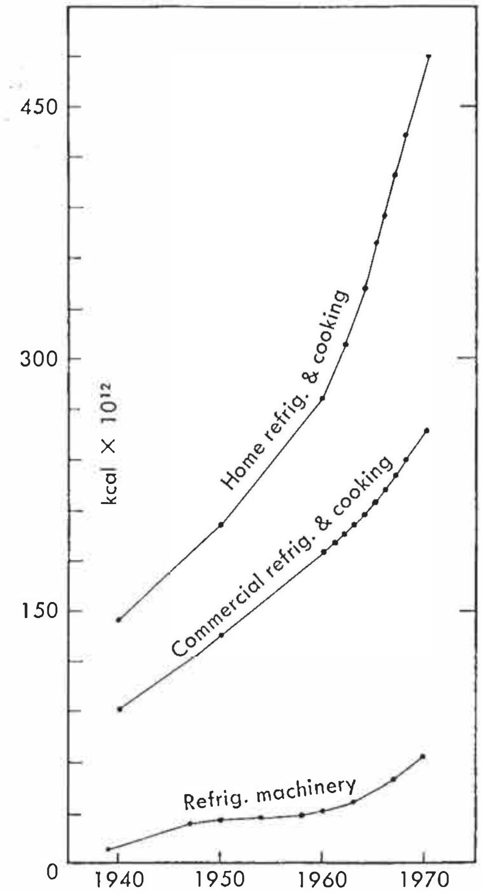


Fig. 3. Commercial and home energy use in the food system. These are selected uses only.

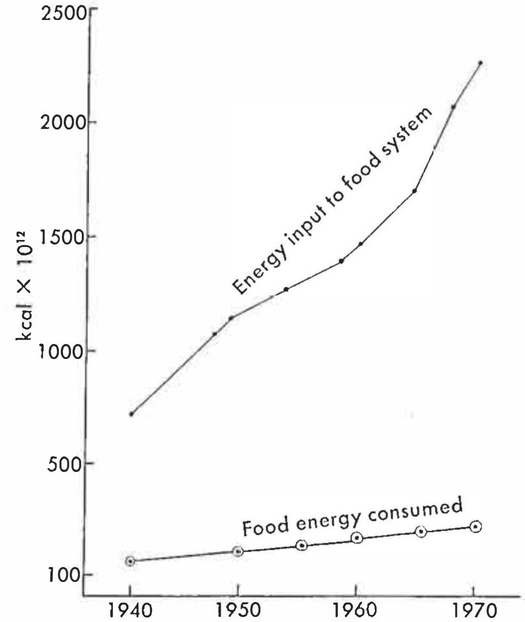


Fig. 4. Energy use in the food system, 1940-1970, compared to caloric energy content of food consumed.

values is easiest (and we believe most accurate) if they are taken for the whole system.

After food is processed there is further energy expenditure. Transportation enters again, and some fraction of the energy used for transportation should be assigned here. But there are also the distributors, wholesalers and retailers, whose freezers, refrigerators and very establishments are an integral part of the food system. There are also the restaurants, schools, universities, prisons, and a host of other institutions engaged in the procurement, preparation, storage, and supply of food. We have chosen to examine only 3 categories: the energy used for home refrigeration and cooking, for commercial refrigeration and cooking, and that used for the manufacture of the refrigeration equipment. [Figure 3] shows energy consumption for these categories. There is no attempt to include the energy used in trips to the store or restaurant. Garbage disposal has also been omitted, although it is a persistent and growing feature of our food system. Twelve percent of the nation's trucks are engaged in waste disposal which is largely, though not entirely, related to food. If there is any lingering doubt that these activities—both the ones included and the ones left out—are an essential feature of our present food system, one need only ask what would happen if everyone should attempt to get on without a refrigerator or freezer or stove? Certainly the food system would change.

. . . As for many activities in the past few decades, the story [of primary energy use by the U.S. food system] is one of continuing increase. The totals [for 1940 to 1970] are displayed in [Figure 4] along with the energy value of the food consumed by the public. The food values were obtained by multiplying the annual caloric intake with the population. The difference in caloric intake over this 30-year period is not significant and the curve mostly indicates the population increase in this period.

PERFORMANCE OF AN INDUSTRIALIZED FOOD SYSTEM

The difficulty with history as a guide for the future or even the present lies not so much in the fact that conditions change—we are at least continually reminded of that fact—but that history is only one experience of the many that might have been. The U.S. food system developed as it did for a variety of reasons, many of them probably not understood. It would do well to examine some of the dimensions of this development before attempting to theorize about how it might have been different, or how parts of this food system can be transplanted elsewhere.

Energy and food production

[Figure 5] displays features of our food system not easily seen from economic data. The curve shown has no theoretical basis, but is suggested by the data as a smoothed recounting of the history of increasing food production. It is, however, similar to growth curves of the most general kind, and it suggests that, to the extent that the increasing energy subsidies to farm production have increased that production, we are near the end of an era. . . . there is an exponential phase which began in 1920 or earlier and lasted until 1950 or 1955. Since then the increments in production obtained by the growth in energy use have become smaller. It is likely that further increases in food production from increasing energy inputs will be harder and harder to come by. Of course, a major modification in the food system could change things. However, the argument advanced by the technological optimists—that we can always produce more if we have enough energy and that no other major changes are needed—is not supported by our own history.

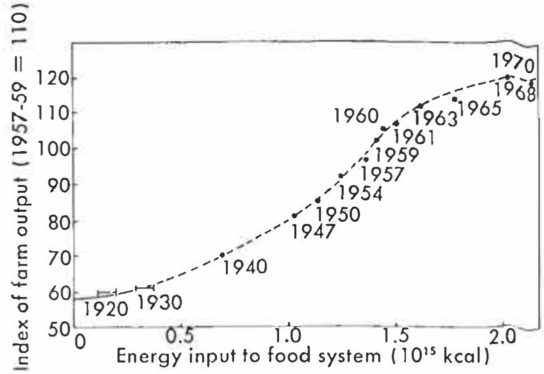


Fig. 5. Farm output as a function of energy input to the U.S. food system, 1920-1970.

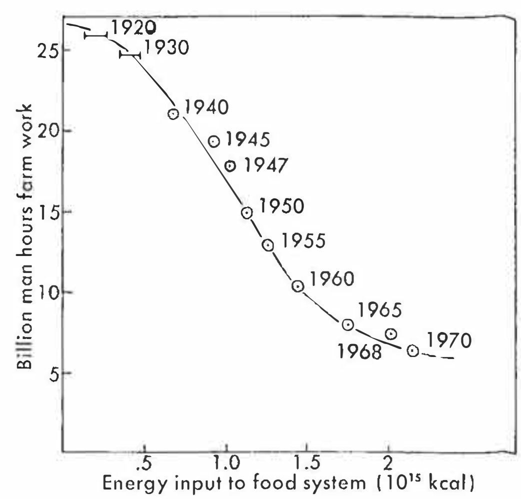


Fig. 6. Labor use on farms as a function of energy use in the food system.

Energy and labor in the food system

One farmer now feeds 50 people, and the common expectation is that labor inputs to farming will continue to decrease in the future. Behind this expectation is the assumption that continued application of technology—and energy—to farming will substitute for labor. [Figure 6] is the substitution curve of energy for labor on the farm. It shows the historic decline in farm labor as a function of the energy subsidy to the food system. Again the familiar "S" shaped curve may be seen. Reduction of farm labor by increasing energy inputs cannot go much further.

The food system that has grown during this period has provided a great deal of employment that did not exist 20, 30 or 40 years ago. Perhaps even the idea of a reduction of labor input is a myth when the food system is viewed as a whole, instead of examining the farm worker only. Pimentel and associates cite an estimate of two farm support workers for each person employed on the farm.[3] To this must be added employment in food processing industries, in food wholesale and retail establishments and in the manufacturing enterprises that support the food system. Yesterday's farmer is today's canner, tractor mechanic and fast food carhop. The process of change has been painful to many ordinary people. The rural poor, who could not quite compete in the industrialization of farming, migrated to the cities. Eventually they found other employment, but one must ask if the change was worthwhile. The answer to that question cannot be provided by energy analysis any more than by economic data, because it raises fundamental questions about how individuals would prefer to spend their lives. But if there is a stark choice of long hours as a farmer, or shorter hours on the assembly line of a meat packing plant, it seems clear that the choice would not be universally in favor of the meat packing plant. Thomas Jefferson dreamed of a nation of independent small farmers. It was a good dream, but society did not develop in that way. Nor can we turn back the clock to recover his dream. But in planning our future, we had better look honestly at our collective history, and then each of us look closely at his own dreams.

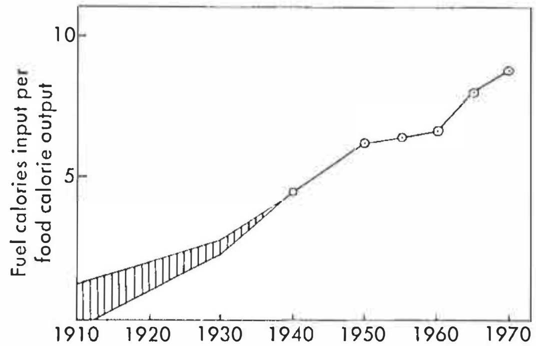


Fig. 7. Energy subsidy to the food system to obtain one food calorie. The values for period 1910-1937 cannot be fully documented, and thus we present a range of values for that period.

The energy subsidy to the food system

The data on [Figure 5] can be combined to show the energy subsidy provided to the food system for the recent past. We take as a measure of the food supplied, the caloric content of the food actually consumed. This is not the only measure of the food supplied, as many protein-poor peoples of the world clearly show. Nevertheless the ratio of caloric input to output is a convenient way to compare our present situation with the past. [Figure 7] shows the history of the U.S. food system in terms of the number of calories of energy supplied to produce one calorie of food for actual consumption. It is interesting and possibly frightening to note that there is no indication that this curve is leveling off. Fragmentary data for 1972 suggest that the increase continued unabated. We appear to be increasing the energy input even more. Note that a graph like [Figure 7] could go to zero. A natural ecosystem has no fuel input at all, and those primitive people who live by hunting and gathering have only the energy of their own work to count as input.

Some economic features of the U.S. food system

The markets for farm commodities in the United States come closer than most to the economist's ideal of a free market. In a free market there are many small sellers, many buyers, and thus no individual is able to affect the price by his own actions in the marketplace. But a market would satisfy these conditions only in the absence of intervention in its function. Government intervention in the prices of agricultural products (and hence of food) has been a prominent feature of the U.S. food system for at least thirty years. Between 1940 and 1970 total farm income has ranged from $4.5 to $16.5 billion, and that part of the National Income having its origin in agriculture (which includes indirect income from agriculture) has ranged from $14.5 to $22.5 billion. Meanwhile government subsidy programs, primarily farm price supports and soil bank payments, have grown from $1.5 billion in 1940 to $6.2 billion in 1970. In 1972 these subsidy programs had grown to $7.3 billion despite foreign demand for U.S. agricultural products. Viewed in a slightly different way, direct government subsidies have accounted for 30 to 40 percent of farm income and they have accounted for 15 to 30 percent of the National Income attributable to agriculture for the years since 1955. The point is important because it emphasizes once again the striking gap between the economic description of society and the economic models used to account for that society's behavior.

The issue of farm price supports is related to energy in this way: first government intervention in the food system is a feature of almost all highly industrialized countries (and, despite the intervention, farm incomes still tend to lag behind national averages); and secondly, because reduction of the energy subsidy to agriculture (even if we could manage it) might reduce farmer's incomes. One reason for this state of affairs is that quantitative demand for food has definite limits and, without farm price supports, the only way to increase farm income is to increase the unit cost of agricultural products. Consumer boycotts and protests in the early 1970s suggest that there is considerable resistance to this course of action.

Government intervention in the functioning of the market for agricultural products has increased with the use of energy in agriculture and the food supply system and we have nothing but theoretical suppositions to suggest that either event could happen alone.

SOME ENERGY IMPLICATIONS FOR THE WORLD FOOD SUPPLY

The food supply system of the United States is complex and interwoven into a highly industrialized economy. We have tried to analyze this system owing to its implications for future energy use. But the world is also short of food. A few years ago it was widely predicted that the world would experience widespread famine in the 1970s. The adoption of new high-yield varieties of rice, wheat, and other grains has caused some experts to predict that the threat of these expected famines can now be averted—perhaps indefinitely. Yet, despite increases in grain production in some areas, the world still seems to be headed towards famine. The adoption of these new varieties of grain—dubbed hopefully the green revolution—is an attempt to export a part of the energy-intensive food system of the highly industrialized countries to non-industrialized countries. It is an experiment, because the whole food system is not being transplanted to new areas, but only a small part of it. The green revolution requires a great deal of energy. Many of the new grain varieties require irrigation in places where traditional crops did not, and almost all the new crops require extensive fertilization. Both irrigation and fertilization require high inputs of energy.

The agricultural surpluses of the 1950s have largely disappeared. Grain shortages in China and the U.S.S.R. have attracted attention because they have brought foreign trade across ideological barriers. There are other countries that would probably import considerable grain if they could afford it. But only four countries may be expected to have any substantial excess agricultural production: Canada, New Zealand, Australia, and the United States. None of these is in a position to give grain away, because they need the foreign trade to avert ruinous balance of payment deficits. Can we then export energy-intensive agricultural methods instead?

Energy-intensive agriculture abroad

It is quite clear that the United States food system cannot be exported intact at present. For example, India has a population of 550×10^6 persons. To feed the people of India at the United States level of about 3,000 kilocalories per day (instead of their present 2,000) would require more energy than India now uses for all purposes. If we wished to feed the entire world with a food system of the U.S. type almost 80 percent of the world's annual energy expenditure would be required.

The recourse most often suggested is to export only methods of increasing crop yield, and to hope for the best. We must repeat that this is an experiment. We know that our food system works (albeit with some difficulties and warnings for the future) but we do not know what will happen if we take a piece of that system and transplant it to a poor country that is lacking the industrial base of supply, transport system, processing industry, appliances for home storage and preparation, and most of all, a level of industrialization permitting higher food costs.

The energy requirements of green revolution agriculture have some important political and social implications. To the extent that the Western, highly industrialized countries must continue research and development for the new strains continually required to respond to new plant diseases and pests that can and do sweep through areas planted with a single variety (consider the recent problem with corn blight in the midwest), the Western countries will possess a hold over the developing countries. Political radicals sometimes dub this state of affairs "technological imperialism," but, whatever the name, the developing countries resent their dependence upon the vagaries of another nation's priorities. In order to avoid this source of friction the improved agriculture must be managed within the developing countries. In many of the developing countries such internal programs have begun. But establishment of anything like the agricultural extension network of the United States will require a significant expenditure of energy. Failure to establish networks of this type has, in some green revolution areas, favored the better-educated farmer against the peasants, who have little access to or knowledge of the new grain varieties. The necessity to fertilize and irrigate also favors the larger, more affluent farms—often with the result of driving more peasants off the land and into the cities, where developing nations face a difficult problem already.

Fertilizers, herbicides, pesticides and in many cases, machinery and irrigation are needed to have any hope of success with the green revolution. Where is the energy for this to come from? Many of the nations with the most serious food problem are also those with scant supplies of fossil fuels. In the industrialized nations, solutions to the energy supply problems are being sought in nuclear energy. This technology-intensive solution, even if successful in advanced countries, poses additional problems for underdeveloped nations. To create the base of industry and technologically sophisticated people within their own country will be beyond many of them. Once again they face the prospect of depending upon the good will and policies of industrialized nations. Since the alternative could be famine, their choices are not pleasant, and their irritation at their benefactors—ourselves among them—could grow to threatening proportions. It would be comfortable to rely on our own good intentions, but our good intentions have often been unresponsive to the needs of others. The matter cannot be glossed over lightly. World peace may depend upon the outcome.

Choices for the future

Application of energy on our farms is now near 10^3 kcal/m^2 per year for corn,[3] and this is more or less typical of intensive agriculture in the United States. With this application of energy we have achieved yields of 2×10^3 kcal/m^2 per year of usable grain—bringing us to almost half of the photosynthetic limit of production. Further applications of energy are likely to yield little or no increase in the level of productivity. In any case research is not likely to improve the efficiency of the photosynthetic process itself. There is a further limitation of improvement of yield. Faith in technology and research has at times blinded us to the basic limitations of the plant and animal material with which we work. We have been able to emphasize desirable features already present in the gene pool, and to suppress others that we find undesirable. At times the cost of increased yield is the loss of desirable characteristics—hardiness, resistance to disease and adverse weather and the like. The further we get from characteristics of the original plant and animal strains, the more care—and energy—is required. Choices must be made in the directions of plant breeding. And the limitations of the plants and animals we use must be kept in mind. We have not been able to alter the photosynthetic process, or to change the gestation period of animals. In order to amplify or change an existing characteristic we will probably have to sacrifice something in the overall performance of the plant or animal. If the change requires more energy, we could end with a solution that is too expensive for people who need it most. These concerns are intensified by the degree to which energy becomes more expensive in the world market.

WHERE NEXT FOR FOOD?

[Figure 8] shows the energy subsidy ratio to energy output for a number of widely used foods in a variety of times and cultures. For comparison the overall behavior of the United States food system is shown, but the comparison is only approximate because, for most of the specific crops, the energy input ends at the farm. As has been pointed out, it is a long way from the farm to the table in industrialized societies. Several things are immediately apparent, and coincide with expectations. High protein foods, such as milk, eggs, and meat, have a far poorer energy return than do plant foods. Because protein is essential for human diets, and because the amino acid balance necessary for good nutrition is not found in most cereal grains, we cannot abandon meat sources altogether. [Figure 8] indicates how unlikely it is that increased fishing or production of fish protein concentrate will solve the world's food problems. Even if we leave aside the question of whether the fish are available—a point on which expert opinions differ—it would be hard to imagine, with rising energy prices, that fish protein concentrate will be anything more than a by-product of the fishing industry, for it requires more than twice the energy of production of grass-fed beef or eggs. Distant fishing is still less likely to solve food problems. On the other hand, coastal fishing is relatively low in energy cost. Unfortunately, however, coastal fisheries are threatened with overfishing as well as pollution.

The position of soybeans may be crucial in [Figure 8]. Soybeans possess the best amino acid balance and protein content of any widely grown crop. This has long been known to the Japanese, who have made soybeans a staple of

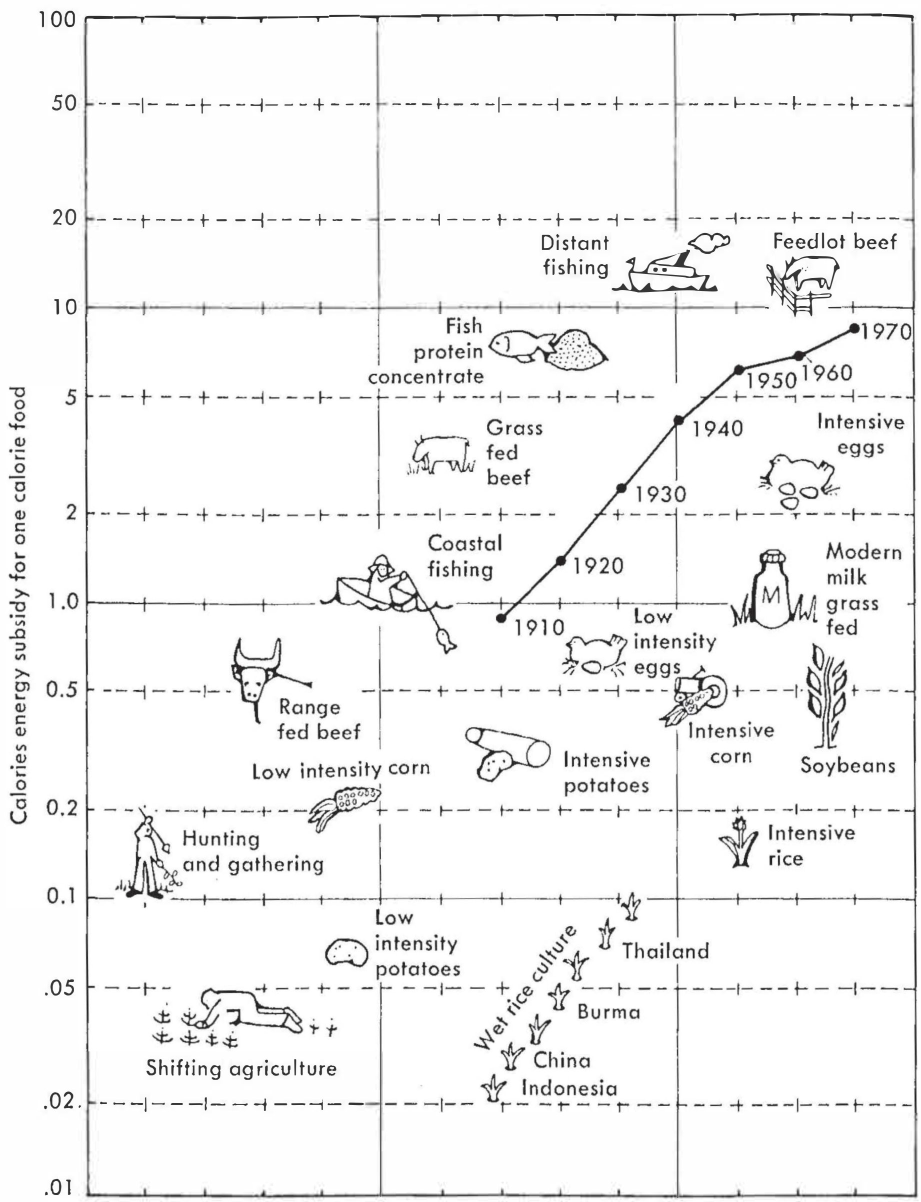


Fig. 8. Energy subsidies for various food crops. The energy history of the U.S. food system is shown for comparison.

their diet, and to beef feedlot operators. Are there other plants, possibly better suited for local climates, which have adequate proportions of amino acids in their proteins? There are about 80,000 edible species of plants, of which only about 50 are actively cultivated on a large scale (and 90 percent of the world's crops come from only 12 species). We may yet be able to find species that can help the world's food supply.

The message of [Figure 8] is simple. In primitive cultures, 5 to 50 calories of food were obtained for each calorie invested. Some highly civilized cultures have done as well and occasionally better. In sharp contrast, industrialized food production requires an input of 5 to 10 calories of fuel to obtain 1 calorie of food. We must pay attention to this difference—especially if energy costs increase. If some of the energy subsidy for food production could be supplied on-site, with renewable sources—primarily sun and wind—we might be able to provide an energy subsidy. Otherwise the choices appear to be less energy-intensive food production or famine for many areas of the world.

Energy reduction in agriculture

It is possible to reduce the amount of energy required for agriculture and the food system. A series of thoughtful proposals by Pimentel and associates deserve wide attention.[3] Many of these proposals mitigate environmental problems, and any reductions in energy use provide direct reduction of the pollutants due to fuel consumption as well as more time to solve our energy supply problems. Among the suggestions made by Pimentel and associates are the following.

First, we should use natural manures. The United States has a pollution problem from runoff from animal feedlots, and yet we apply large amounts of manufactured fertilizer to fields. More than one million kcal per acre could be saved by substituting manure for manufactured fertilizer (and as a side benefit, the condition of the soil would be improved). Widespread use of natural manure will require decentralization of feedlot operations so that manure is generated closer to the point of application. Decentralization would increase feedlot costs, but if energy prices rise, feedlot operations will rapidly become more expensive in any case. Crop rotation is less widely practiced than it was even twenty years ago. Increased use of crop rotation or interplanting winter cover crops of legumes (which fix nitrogen as a green manure) saves 1.5 million kcal per acre compared to commercial fertilizer.

Second, weed and pest control could be accomplished at a much smaller cost in energy. A 10 percent saving of energy in weed control could be obtained by using the rotary hoe twice in cultivation instead of using herbicides (again with pollution abatement as a side benefit). Biologic pest control—that is, the use of sterile males, introduced predators and the like—requires only a tiny fraction of the energy needed for pesticide manufacture and application. A change to a policy of "treat when and where necessary" in pesticide application would bring a 35 to 50 percent reduction in pesticide use. Hand application of pesticides requires more labor than machine or aircraft application, but the reduction of energy is from 18,000 kcal per acre to 300 kcal per acre. Changed cosmetic standards, which in no way affect the taste or edibility of food stuffs, could also bring about a substantial reduction in pesticide use.

Third, the directions in plant breeding might emphasize hardiness, disease and pest resistance, reduced moisture content (to end the wasteful use of natural gas in drying crops), reduced water requirements, and increased protein content—even if it means some reduction in overall yield. In the longer run, plants not now widely cultivated might receive some serious attention and breeding efforts.

The direct use of solar energy on farms, a return to wind power (using the modern windmills now in use in Australia), and the production of methane from manure are all possibilities. These methods require some engineering to be economically attractive, but it should be emphasized that these technologies are now better understood than is the technology of breeder reactors. If energy prices rise, these methods of energy generation would be attractive alternatives even at present costs of implementation.

Energy reduction in the U.S. food system

Beyond the farm, but still far short of the table, many more energy savings could be introduced. The most effective way to reduce the large energy requirements of food processing would be a change in eating habits towards less highly processed foods. The current dissatisfaction with many processed foods from "marshmallow" bread to hydrogenated peanut butter could presage such a change, if it is more than just a fad. Technological changes could reduce energy consumption on an industry by industry basis but the most effective way to encourage the adoption of methods using less energy would be to increase the cost of energy. Such price increases almost certainly await us.

Packaging has long since passed the stage of simply holding a convenient amount of food together and providing it with some minimal protection. Legislative controls may be needed in packaging to end the spiralling competition of manufacturers in amount and expense of packaging. In any case, recycling of metal containers and wider use of returnable bottles could reduce this large energy use.

The trend toward the use of trucks in food transport to the virtual exclusion of trains should be reversed. By simply reducing the direct and indirect subsidies of trucks, we might go a long way toward enabling trains to compete.

Finally, in the home we may have to ask whether the ever larger frostless refrigerators are needed, and whether the host of kitchen appliances really mean less work.

Store delivery routes, even by truck, would require only a fraction of the energy used by private autos for food shopping. Rapid transit, giving some attention to the problems of shoppers with parcels would be even more energy-efficient.

If we insist on a high energy food system, we should consider starting with coal, oil, garbage—or any other source of hydrocarbons—and producing food in factories from bacteria, fungi, and yeasts. These products could be flavored and colored appropriately for cultural tastes. Such a system would be more efficient in use of energy, solve waste problems, and permit much or all of the agricultural land to be returned to its natural state.

Energy, prices, and hunger

If energy prices rise—as they have already begun to do—the rise in the price of food in societies with industrialized agriculture can be expected to be even larger than the energy price increases. Slesser, in examining the case for England, suggests that a quadrupling of energy prices in the next forty years would bring about a sixfold increase in food prices.[5] Even small increases in energy costs may make it profitable to increase labor input to food production. Such a reversal of the fifty year trend toward energy-intensive agriculture would present environmental benefits as a bonus.

We have tried to show how analysis of the energy flow in the food system illustrates features of the food system that are not easily deduced from the usual economic analysis. Despite some suggestions for lower intensity food supply and some frankly speculative suggestions, it would be hard to end this chapter on a note of optimism. The world drawdown in grain stocks which began in the mid 1960s continues, and some food shortages are likely throughout the 1970s and early 1980s. Even if population control measures begin to limit world population, the rising tide of hungry people will be with us for some time.

Food is basically a net product of an ecosystem, however simplified. Food starts with a natural material, however modified later. Injections of energy (and even brains) will carry us only so far. If humankind cannot adjust its wants to the world in which it lives, there is little hope of solving the food problem for mankind. In that case the problem will solve mankind.

NOTES

1. *Statistical Abstract of the United States*, 1973.
2. *Historical Statistics of the United States* (Washington, D.C., 1960).
3. D. Pimentel et al., "Food Production and the Energy Crisis." *Science* 182 (1973): 443-449.
4. N. Georgescu-Roegen, *The Entropy Law and the Economic Process* (Cambridge, Mass.: Harvard University Press, 1971), 301.
5. M. Slesser, "How Many Can We Feed?," *The Ecologist* 3 (1973): 216-220.

Of mites and men

In which scientists and environmentalists argue about the right way to kill insects

WILLIAM TUCKER

■ William Tucker *is a contributing editor of* Harper's *magazine. His article "Environmentalism and the Leisure Class"* (Harper's, *December 1972) earned him an Honorable Mention in the Annual Gerald Loeb Awards. He also was recently chosen a winner of the Annual John Hancock Awards. Both awards are for excellence in business and financial journalism.*

In "Of Mites and Men" Tucker addresses the issue of biological insect control. A case history of a company engaged in the development and sale of biological insecticides is cited. As a result of obstacles placed by the Environmental Protection Agency in the path of biological-control research and the sale of products resulting from such research, the company experienced serious financial difficulties and was subsequently sold. Tucker blames the policies of the EPA on environmentalists, and launches a severe attack against them. In particular he singles out Rachel Carson's book Silent Spring, *in which he sees the "embryonic form" of the later "excesses of environmentalists." Three claims made by environmentalists and defended in Carson's book are assessed and disposed of. They are: (1) that in the good old days, the "pre-pesticide past," the crops were good and the insects were few; (2) that there are "natural" and "unnatural" chemicals, pesticides being of the latter sort; and (3) that "unnatural" chemicals, like pesticides, cause cancer.*

Nothing is easier than to admit in words the truth of the universal struggle for life, or more difficult—at least I found it so—than constantly to bear this conclusion in mind.

Charles Darwin, *The Origin of Species*

In the early 1950s, a small company named Nutrilite Products, Inc., in Buena Park, California, was making a modest income selling a vitamin supplement guaranteed to be made completely from "natural" products. The vitamins were extracted from alfalfa grown on Nutrilite's 1,000-acre farm in the San Jacinto Valley, 100 miles northeast of Los Angeles. The company was using only "organic" humus fertilizers and no chemical pesticides when, in 1953, it discovered an infestation of small, green aphids eating their way through the crop.

Nutrilite felt morally obliged to avoid treating its fields with chemical pesticides, so the late Carl Rehnborg, founder of Nutrilite, consulted agricultural scientists at the University of California at Riverside, who suggested he try spreading an insect-attacking fungal disease among the aphids. "We did it and it worked," Rehnborg wrote later. "It was a great moment in the history of this company.

Two years later, in 1955, when Nutrilite's alfalfa fields were again attacked by the voracious catepillar larvae of a small, mothlike lepidopterous insect, Nutrilite again turned to the universities. This time Rehnborg was directed to Berkeley, where Dr. Edward A. Steinhaus, often called the "father of insect pathology in the United States," introduced him to an insect-attacking bacteria called *Bacillus thuringiensis,* which had been first isolated in Germany in 1911. "BT," as it came to be called, was known to infest a wide variety of lepidopterous (moth and butterfly) larvae, while being completely harmless to humans, animals, and other insect families. Once again, the product worked.

Rehnborg was impressed and began considering marketing BT for use against the dozens of lepidopterous insects that variously attack cotton, vegetables, fruit orchards, forest trees—almost every form of vegetation. He hired an entomologist named Dr. Abdul Chauthani, who went to work in Nutrilite's small laboratory, developing various strains of BT and trying to isolate other insect-attacking bacteria and viruses. In 1960, at a cost of $300,000, Nutrilite was able to register BT with the U.S. Department of Agriculture for use against the cabbage looper. Since the USDA would require similar "efficacy" testing for use of BT against each separate pest on each separate crop, Nutrilite limited its work to cabbages and tried to save enough money to extend registration to other crops. Several larger companies in the pesticide field noted Nutrilite's success and registered BT for other uses. By 1962, when naturalist-author Rachel Carson first publicized the "biological control" of insects as an alternative to toxic chemicals like DDT, she was able to describe *Bacillus thuringiensis* as one of the most promising "alternate" methods, already used successfully against alfalfa pests in California, gypsy moths in Canada and Vermont, and banana-eating insects in Panama.

For the next ten years, the pace of research accelerated at Nutrilite, and by 1970 Dr. Chauthani and other researchers had isolated a wide range of bacteria and viruses that could selectively attack a variety of insects. The company had obtained two "experimental-use" permits from the USDA and had about ten other promising products waiting to go into registration procedures, when it ran into an unusual and unexpected opponent—the environmental movement and the newly formed Environmental Protection Agency (EPA).

In 1972, the EPA, formed after nearly a decade of public agitation about environmental problems, began enforcing the brand-new Federal Environmental Pesticide Control Act, passed that year. The bill had been adopted in response to widespread public fears about DDT and other chemical pesticides, first raised by Carson's *Silent Spring*, published in 1962. Responding to the Congressionally mandated task of reviewing registration of all 30,000 existing pesticides, in addition to enforcing tighter registration requirements against new pesticides, the EPA revoked Nutrilite's two-year-old experimental permits and asked for two more years of data proving that insect bacteria and viruses could be used safely in the environment. Nutrilite would be forced to spend about $200,000 on testing before it could begin *experimenting* with the bacteria again. In addition, there would eventually have to be extensive toxicity testing to prove that the bacteria would not have unintended effects on small mammals, fish, birds, marine life, or farm animals, nor would it leave residues that might produce cancer, mutations, or birth defects in humans. What was worse, the EPA itself seemed unsure about how the strict environmental standards should be applied to such "biological" controls. "The EPA changed its mind so many times, we gave up trying to figure out what they wanted," said Dr. Chauthani when I interviewed him by telephone this spring.

After several years of frustration Nutrilite retrenched its efforts to register new products, and tried to continue making money with BT. By 1971, however, Abbott Laboratories had developed another strain of BT that worked more effectively. Nutrilite would have to switch to the new strain to remain competitive, but company officials soon realized that the EPA was going to require complete re-registration of the new strain even though it was genetically only slightly different from the old one. In desperation, Nutrilite proposed combining its old BT strain with the newly developed pyrethroids, a synthetic version of the pyrethrin chemicals derived from the chrysanthemum flower and used against insects for centuries. The EPA informed Nutrilite that it would still have to go through the $500,000 registration procedure for each separate insect on each separate crop because the new synthetic pyrethrins had not been proved to be safe, even though they are almost the same chemical compounds as the natural pyrethrins that are known to be safe.

With nowhere to go, Nutrilite withdrew its own BT strain from the market in 1975, and has since abandoned all further research on insect bacteria and viruses. The company has decided to continue some research in breeding parasitic insects *simply because this form of biological control has not yet been required to go through registration procedures by the EPA*. The company was financially weakened by its unsuccessful venture into biological controls, and in 1975 most of its stock was bought by the Amway Corporation, a Michigan firm that sells shoe polish and cleaning products door-to-door through a franchising system. Amway officials say they intend to continue spending some money for insect-control research, but are mainly interested in marketing Nutrilite's vitamin supplement.

"We're very bitter," said Dr. James Cupello, manager of insect-control research at Nutrilite, when I talked to him on the phone in March. "But this company is not going to spend another penny trying to develop biological controls as long as we have to go through the EPA. The risks are too great that we'd spend a million dollars on research and four years later we'd find out that the EPA wouldn't let us register the product. We've had the reputation of being the leading marketing company for biological controls in this country, but nobody is going to be able to do anything in this field as long as they have to contend with the EPA. We're going back to making vitamin supplements and trying to stay as far away as possible from the Environmental Protection Agency."

I first became interested in finding out what happened to Rachel Carson's "other road" of biological insect-controls after reading several newspaper stories on the subject in the past two years. Each of these accounts told of the wonders that had been coming out of the laboratories over the past decade—insect chemical mating signals, or "sex pheromones," had been molecularly decoded and synthesized so they could be broadcast on infested fields where they would turn the insects' mating attempts into a three-ring circus; "juvenile" and "anti-juvenile" hormones had been discovered that could either keep insects forever young and sexually immature or make them try to metamorphose prematurely into adults before they had even had time to grow their larval whiskers; strange bacterial and viral diseases had been isolated that attacked only certain insects and left other species unharmed. Checking back into *Silent Spring*, I found that the early research on all these methods of biological control had been the main substance of Rachel Carson's "other road" of biological controls that would lead us away from toxic chemicals like DDT.

But there was a curious footnote in all these stories that usually didn't occur until about the last three paragraphs. For some incomprehensible reason, the Environmental Protection Agency was not allowing any of these new "third generation" pesticides to be registered without demanding the enormously expensive testing procedures originally designed to keep chemicals like DDT and the other "bad" pesticides off the market. As a result, most of these new methods were still languishing in the laboratories. The situation was always treated as some odd mistake, some bureaucratic foul-up that would be straightened out as soon as the EPA could settle down, stop "reorganizing," and understand the facts clearly. No one seemed willing to consider that the generals at the EPA might still be fighting the last war, and that the broad snare of regulation designed to capture DDT and other "old-fashioned" pesticides had now entangled the new generation of pesticides as well. It appears, however, that that is what has happened.

The biological controls that Rachel Carson offered as the other road to pest control have indeed come of age after a decade of brilliant research by American chemists and entomologists. Scientists have discovered all anybody would ever want in an insecticide—carefully isolated chemicals that attack only the "target" pests, leave beneficial insects unharmed, and seem to leave no long-term residues that could harm other organisms in the environment. But while these serious research specialists were seeking the answers to environmental problems in the laboratories, another army of enthusiasts was traveling its own other road, which led straight to Washington. This was the environmental movement, a concatenation of glorious amateurs, "aroused" citizens with a knack for talking about what they really didn't understand, vocationless aristocrats defending the imagined glories of the past, housewives with a flare for writing publicity releases, lawyers with a talent for histrionics, and "militant" scientists and academics with a willingness to shade the truth just a bit in pursuit of a "good cause." This army arrived in the Capital in the early 1970s, quickly routed DDT and its allied devils, occupied offices close to Capitol Hill, and have roamed the halls of Congress ever since. Its major accomplishment has been to build a wall of regulation so solid and insurmountable that almost *no* pesticides should ever be able to scale it again. When the serious scientists, who had attempted a positive approach to the problem, arrived in Washington with the results of their research, they ran up against the brick wall of the Environmental Protection Agency. They have been fruitlessly beating their heads against it ever since. . . .

MYTHS OF ENVIRONMENTALISM

There are three fundamental problems that have caused the current dilemma of environmentalism. First, there is the myth, which environmentalists have fashioned, of an ideal, preindustrial, prepesticide past, when crops were good, living was easy, and insects were few. This is a complete fantasy. Second, there is the false distinction between "natural" and "unnatural" chemicals, and the implicit assumption that chemicals like pesticides never occur in nature. Third, there is the myth that these "unnatural" chemicals are causing an equally mythical "epidemic" increase in cancer. Unfortunately, the genesis of all three of these ideas can be traced directly to *Silent Spring*.

Silent Spring is a great book, and for the most part has stood the test of time. No one would argue that it was not enormously successful in alerting the public to the dangers of pesticide use and to some of the worst abuses that were then prevalent. It is hard to believe, for example, that whole towns were once sprayed with highly toxic chemicals in an effort to wipe out a single pest species lurking somewhere among the leaves. It also brought to public attention the persistence of some pesticides, and their magnification through the food chain. For this we owe Rachel Carson an enormous debt.

But *Silent Spring* is also a terrible book, and the future excesses of environmentalism appear in embryonic form on every page. In discussing what she calls the system of "deliberately poisoning our food" with pesticides, Carson says:

> But if, as is now the presumable goal, it is possible to use chemicals in such a way that they leave a residue of only 7 parts per million (the tolerance of DDT), or 1 part per million (the tolerance for parathion), or even of only 0.1 part per million as is required for dieldrin on a great variety of fruits and vegetables, then why is it not possible, with only a little more care, to prevent the occurrences of any residues at all?

The constant insistence on "zero pollution levels" has proved to be the most costly and unenforceable aspect in much environmental legislation. More important, however, is the argument that DDT and other pesticides were causing what Carson called "an alarming increase in malignant disease" (cancer), the proof of which is entirely contained in the following sentence: "The monthly report of the Office of Vital Statistics for July, 1959, states that malignant growths, including those of the lymphatic and blood-forming tissues, accounted for 15 percent of the deaths in 1958 compared with only 4 percent in 1900." A high school student would probably blush at the distortion. In 1900, the average American lived to be forty-five and had a good chance of dying of influenza. In 1962, the same citizen could expect to live to seventy and was therefore six times more likely to contract cancer, which is predominantly a disease of old age. The only reason the *percentage* of cancer deaths has increased is because industrial civilization has allowed people to live longer, and bacterial diseases have essentially been eliminated.

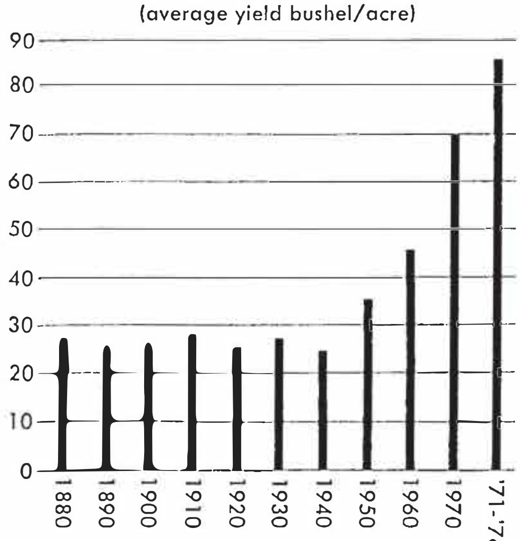
The myth of the pest-free past was not explicit in Rachel Carson's book, but was implied by her failure even to *mention* the problems of controlling insects in agriculture. This omission caused one writer, environmentalist LaMont Cole, in reviewing the book for *Scientific American,* to remark: "She does not convey an appreciation of the really great difficulties of the problem [of insect control]. . . . But what I interpret as bias and oversimplification may be just what it takes to write a best-seller." Rather than heeding such warnings, however, the environmental movement has woven an elaborate vision of a mythical, pest-free past against which the problems of current pest-control methods can be contrasted. This fallacy was recently reiterated in the *Washington Post's* front-page Sunday editorial section, in an article entitled "The Pesticide Plague" (March 5, 1978):

> Before synthetic pesticides hit the market in 1946, corn belt farmers didn't have many insect problems. They grew a rich diversity of crops, rotating them from one field to the next. That way the pests attracted to any single crop could not sweep the farm like a plague. But with the birth of the Green Revolution, small, diverse farms were wiped out and massive monocultures, vast tracts of a single crop planted year after year, spread across the corn belt. . . . What have [the farmers] got to show for it? Since pesticides came to the farms, pest damage to corn has not decreased. The latest USDA estimates indicate corn losses from pests have in fact more than tripled. . . ; [meanwhile] the major pesticide producers—petrochemical giants such as Dow, du Pont, Monsanto, American Cyanamid, Standard Oil of California (Chevron), Shell—just celebrated a record year, with $3 billion in sales.

In nineteenth-century America, insect problems were so much a part of life that whole towns were sometimes asked to pray for deliverance. Even the pests themselves have not changed to any great degree. Despite the "rich diversity of crops," the Colorado potato beetle easily spread across the Midwest in the 1860s and eventually made it to Europe, where it became a major pest. After the first gypsy moths escaped from a silkworm experiment in Boston in 1869, the streets of New England were so infested that caterpillars were crawling up the sides of houses and into people's beds. The standard method of protecting crops was to spray them with lead arsenate, a practice that produced its own *Silent Spring,* a book called *100,000,000 Guinea Pigs,* which caused a sensation in the 1930s. The introduction of less toxic DDT in 1946 was regarded as a major advance at the time.

Of course, there is some truth to the statement that "monocultures" of corn have replaced the old diversity, although growing a rich variety of crops in the old days often meant simply having a rich variety of pests. But what farmers in the corn belt also have to show for their efforts, despite the misleading "increase" in pest damage, is contained in the following graph:

U.S. corn (maize) production by decades
(average yield bushel/acre)



Based on U.S.D.A. statistics

According to the USDA figures, there was never *any* increase in corn productivity in the United States until synthetic pesticides, chemical fertilizers, and new hybrid varieties were introduced after 1945 (pesticides probably account for only 20 percent of the increase, but have ensured the success of other improvements). To produce the same amount of corn under the old methods would mean that an additional area equivalent to Colorado and Wyoming would have to be planted. Nor have farmers and chemical manufacturers been the only beneficiaries. As John Stuart Mill said: "When commerce is spoken of as a source of national wealth, the imagination fixes itself upon the large fortunes acquired by merchants, rather than upon the savings of price to consumers." Most of the corn is used to raise beef cattle, and as a result Americans now consume twice as much beef as they did in 1940, even though they spend a one-third smaller portion of their income on food.

> That which the palmerworm hath left hath the locust eaten; and that which the locust hath left hath the cankerworm eatern; and that which the cankerworm hath left hath the caterpillar eaten.
>
> **The Book of Joel**

The second and more difficult problem of environmentalism is the widely held belief it has fostered that there is an important distinction between "natural" and "man-made" chemicals, and that it is the "synthetic" chemicals manufactured by industrial society that are the cause of all our problems. Rachel Carson played heavily on this distinction in *Silent Spring*. An infinite number of potential chemicals can be made through nature's system of stringing long carbon chains together in various forms to form the "organic hydrocarbons." Only a fraction of the potential number are actually synthesized in nature, but then objects such as shovels, axes, plows, and most of the other implements of our daily lives do not occur in nature either. There is nothing inherently "evil" (Rachel Carson's word) about changing nature by synthesizing new chemicals, and the distinction that "natural" chemicals are "good" and synthetics are "dangerous" is completely meaningless. There are hundreds of highly dangerous "natural" chemicals, just as there are thousands of perfectly harmless "synthetics." Yet environmentalism has managed to establish the doctrine that everything in nature is "good," while things that are made in the laboratory hold the potential for destruction.

The key sentence that expresses this in *Silent Spring* reads as follows:

> The chemicals to which life is asked to make its adjustment are no longer merely the calcium and silica and copper and all the rest of the minerals washed out of the rocks and carried in rivers to the sea; they are the synthetic creations of man's inventive mind, brewed in his laboratories, and having no counterparts in nature.

This statement is so filled with absurdities and errors that it is hard to know where to begin. In the first place, calcium, copper, and other minerals form only the tiniest fraction of the diet of living organisms. Except for certain onecelled creatures, all living things derive all their energy and most of their substance by taking apart large organic molecules (plants make their own carbohydrates using the sun's energy, and then break them down themselves, process called "autotrophism," or self-nourishment). The point that Carson was probably trying to make was that plants and animals never had to deal with special kinds of organic molecules like the "chlorinated hydrocarbons," but if so, she was *completely* wrong.

Practically every schoolchild knows the story of Dr. Alexander Fleming, the British scientist who in 1928 accidentally dropped some cheese in a bacterial culture and later noticed that a few small, sterilized zones had been created. A variety of Penicillium mold was growing on the cheese, and Fleming discovered that the mold excreted small amounts of a substance that killed bacteria. It was soon realized that a wide variety of soil fungi and other organisms produce antibacterial molds that they use in competing for space with other organisms. Penicillin was the result, and since that time our major effort against bacterial diseases has been a process of imitating these soil organisms. What is not generally known, however, is that many of the chemicals in these antibacterial molds are *chlorinated hydrocarbons*. One of the biggest producers of chlorinated hydrocarbons are the long "ray fungi" (actually bacteria) that illustrate one of the opening chapters of *Silent Spring*, and that Carson describes as "growing in long threadlike filaments" at a rate of more than 1,000 pounds per acre! None of these organisms actually make DDT or other common pesticides, but they do use chemicals that are remarkably similar. One Penicillium fungus excretes a chemical that is only one molecule different from a commonly used fungicide "Dowcide 2S," manufactured by Dow Chemical. In fact, it seems quite possible that the presence of these large amounts of chlorinated hydrocarbons in nature may offer an explanation for the enormously large quantities of "pesticide residues" that environmentalists have always been able to find. (In 1970, Frank Graham, Jr., reported without irony in *Silent Spring* that "the amount of DDT in Swedish soils exceeds the total quantities ever used in that country.") To be sure, scientists who developed the pesticides and herbicides from chlorinated hydrocarbons may not have been aware that they were copying nature so closely, but there was a brilliant kind of inductiveness in that we arrived at the same kinds of chemicals that are used for almost the same purposes in nature.

In one of the most beautiful passages in *Silent Spring*, Rachel Carson writes: "Most of us walk unseeing through the world, unaware alike of its beauties, its wonders, and the strange and sometimes terrible intensity of the lives that are being lived about us." She was talking of the insects and their ever-present predators. But what Carson was only peripherally aware of, and what has emerged clearly only in the past decade of research, is that *plants themselves* are also intensely involved in this struggle for existence, and that their form of "warfare" is largely *chemical* warfare. Simple organisms like fungi and bacteria excrete substances that kill competing organisms in their immediate environment. More complex plants often do the same thing. Certain cacti give off herbicidal chemicals that make it impossible for other plants to germinate in their immediate vicinity. In addition, plants are constantly growing thorns, needles, and tough coatings, and synthesizing chemicals to make themselves bitter, inedible, and even poisonous to animals and insects. In a way it seems foolish for us never to have realized it before, but except in instances where the consumption of fruits and nectars leads to seed generation, *plants do not like to be eaten*. There is no evolutionary advantage for a plant in being eaten, just as there would be no evolutionary advantage for a human being in becoming dinner for a lion. Plants have evolved a vast array of chemicals, from chlorinated hydrocarbons to juvenile-hormone mimics, in trying to protect themselves from becoming dinner for other organisms. The simple proof of the matter is that almost everything we eat—wheat, barley, oats, potatoes, corn, carrots, peas, beans, bananas, oranges, lettuce, tomatoes, the list is endless—is a *human invention* that does not exist in nature. They are completely "unnatural" organisms that we have invented for our own purposes through a process of chemical and genetic manipulation that is in no way different from synthesizing a new organic compound in the laboratory. There is no fundamental difference between changing a few atoms in an organic compound and calling it a "pesticide," and manipulating a few genes on a couple of wild plants and calling the result a "carrot." The brilliant realization of the past decade of research in insect control has been that plants, too, are involved in the process of synthesizing chemicals to protect themselves from insect attack, and that the most fruitful path of research may lie in following the trail they have blazed over the last few hundred million years.

> Of all the chemicals in the whole history of the world that have done the most good for humanity, in terms of limiting disease, in terms of providing food, in terms of relieving suffering, the one that has done the most good would have to be DDT.
>
> **Dr. William Bowers**

The long fight for a complete ban on DDT, and the excesses that were practiced in its pursuit, are what is now haunting the environmental movement in its attempt to replace the chlorinated hydrocarbons and other toxic chemicals with "biological" chemicals. The problem is that there is no basic distinction between the two.

There is no question that there were enormous abuses of DDT and other pesticide chemicals when Rachel Carson wrote *Silent Spring* in 1962. Pesticides were being used with a "shotgun" approach that was having a tremendous impact on wildlife. Carson was on firm ground in voicing these concerns, in part because the same worries had been expressed by scientists for more than fifteen years. Writing a prophetic essay entitled "DDT and the Balance of Nature," published in *Atlantic* magazine in 1945, the same Dr. Wigglesworth who had already identified the juvenile-hormone gland in 1934 wrote:

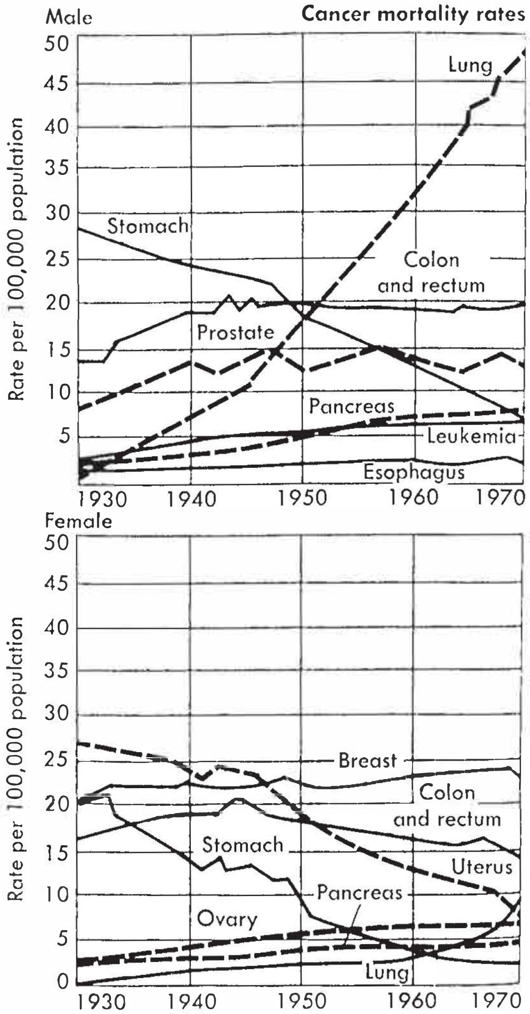
> DDT is like a blunderbuss, discharging shot in a manner so haphazard that friend and foe alike are killed. . . . Without careful study it is impossible to guess what the ultimate results of this process may be. . . . Some fish . . . are reported to have been killed when they fed on poisoned insects. . . . DDT sprayed on peach trees with the object of killing the caterpillars of the Oriental fruit moth is even more effective in killing the parasite that is controlling this pest. . . . It is obvious enough that DDT is a two-edged sword. . . . Chemicals which upset the balance of nature have been known before. DDT is merely the latest and one of the most violent. . . . We need to know far more about [the insects'] ecology—that is, about their natural history studied scientifically. When the ecology of an insect pest is fully known, it is often possible to modify the conditions in such a way that its world no longer suits it. . . . But when all these so-called cultural or naturalistic methods of control have been developed, there remains a large residue of pests for which insecticides must be used.

Although she essentially ignored the warning in the last sentence, Rachel Carson added two more concerns to this list—the unforeseen development that long-lasting pesticide residues would be "magnified" through the food chain, building up in predators and higher organisms, and the concern that insects eventually would develop resistance to pesticides and that ever-increasing doses would have to be used.

This was all well and good, but neither Carson nor the environmentalists were ever willing to admit that it was precisely DDT's long persistence that had in many ways made it a superior pesticide, and that *any* pesticide would eventually face the same problem of growing insect resistance. The pyrethrins are a classic example. Derived from the chrysanthemum flower, the pyrethrins are a group of natural chemicals whose origins were once held a secret by the Persians until they were ferreted out by the English, who started growing large quantities of chrysanthemums in Kenya in the 1880s. Natural pyrethrins presented two problems, however—the laborious method of production could not supply the world market, and the pyrethrins themselves broke down quickly in sunlight. In the 1950s the problems were finally transferred to the laboratories, where scientists soon synthesized the molecule. In 1962, Rachel Carson could write:

> The ultimate answer [to highly toxic pesticides] is to use less toxic chemicals so that the public hazard from their misuse is greatly reduced. Such chemicals already exist: the pyrethrins, rotenone, ryania, and others derived from plant substances. Synthetic substitutes for the pyrethrins have recently been developed so that an otherwise critical shortage can be averted.

But the problem was that, although they were not very toxic to mammals, the pyrethrins were still fairly dangerous to fish. In addition, there was still no adequate solution to the chemicals' short life. A variety of carriers were tried, but finally it became simpler to change the molecule to create a chemical that would last long enough to be effective. Now the pyrethrins were a useful insecticide—but suddenly they were an environmental problem as well. Because of their new persistence, they posed a danger to fish. In addition, now that they were being used more widely, insects were beginning to develop more resistance. Thus, when the USDA began introducing the synthetic pyrethrins into cotton farms in recent years, the Environmental Defense Fund told the EPA it was opposed to their use, *even though these synthetic chemicals had been specifically approved by Rachel Carson in "Silent Spring."* What Carson failed to realize,



and what the environmental movement has since ignored, is that insects are eventually going to build up resistance to *any* chemical, natural or unnatural, just as bacterial diseases have eventually evolved strains that are resistant to antibiotics. There is already evidence that insects are going to be able to develop resistance to juvenile growth hormones, pheromones, and other "bio-rational" controls as well. In short, the battle with the insects is never going to be over, just as the battle against bacterial infection will never really be over.

Rachel Carson's speculation that residues of DDT in human and animal tissues were causing cancer has mushroomed into a widespread public certainty that it is the products of industrial society that are causing an "epidemic" increase in cancer. . . . [the accompanying] graphs of cancer mortality for an age-adjusted population in the United States indicate that there is no "epidemic" increase in cancer in this country. The only instance of a clear increase in cancer rates is lung cancer among men. Ironically, this is the only instance where people are known to have a personal choice in avoiding the carcinogenic material (the National Cancer Institute estimates that 80 percent of lung cancer incidents are the result of smoking). Among the twenty-four leading industrial nations, the United States is sixteenth in cancer mortalities for an age-adjusted population.

What is perhaps most notable in the graph is the steady *decrease* in the rate of stomach cancer over the past forty years. Stomach cancer is rife in underdeveloped countries in Asia and Africa, and the suspected carcinogen is a completely *natural* substance called "aflatoxin," the excretion of a mold that grows in stored peanuts and grains. Cancers of the digestive system occur in underdeveloped countries at rates up to 200 times their incidence in the United States because of aflatoxins, which are among the most potent carcinogens known. The rate of liver cancer from simply *eating* in East Africa is double the rate of liver cancer found among 25,000 industrial workers exposed to one of the most famous industrial carcinogens, vinyl chloride. Moreover, the aflatoxin mold is known to establish itself best in peanuts and grains that have been damaged by insects! The highest quantity of aflatoxin ever found in the U.S. by the Food and Drug Administration was in a jar of "natural" peanut butter. It would be entirely possible to argue that, rather than causing an increase in cancer, pesticides and fungicides have been partly responsible for the notable *decrease* in cancers of the digestive system in industrialized countries.

Most of the notions on which Rachel Carson based her claim that DDT might be causing cancer were highly speculative at the time, and are now a part of medical history. She suggested that DDT acted on all cells by affecting their ability to use oxygen, causing them to mutate back to a more primitive process of "fermentation" in order to break down carbohydrates. The assumption was that this process would affect the nerve cells of insects, causing nerve dysfunctioning, but would produce cancer in the other human and animal cells as well. This was based on another speculation of the time, that cancer cells were also formed by mutations back to this same primitive fermentation process. All these theories have since been abandoned.

It was generally accepted at the time, and has since been proved, that DDT acts as a "nerve poison" by fitting into certain highly specialized receptacles at the end of all nerve cells. Insects are extremely vulnerable since they have no fat tissues in which to store DDT. Humans and other vertebrate animals avoid the nerve poisoning by storing DDT in fat cells, *but they do not go on building up stored quantities indefinitely*. Numerous tests have shown that a peak level is reached, and all new material is immediately excreted, so there is no danger of "slow poisoning" from DDT. In a single dose, DDT has about the same toxicity as aspirin. On the other hand, parathion, which replaced DDT in many uses, is so highly toxic that a single drop in the eye can kill a person. It is interesting to note that although Rachel Carson said as many bad things about parathion as DDT in *Silent Spring*, the environmental movement chose to concentrate its efforts against DDT because of the "slow poisoning" concerns. The result has been that, while the hysteria has been relieved in suburban living rooms, hundreds and hundreds of farm workers and farm children have been poisoned because of the increased use of parathion, and about twenty-five people die each year.

A PHILOSOPHICAL GAME

While *Silent Spring's* theory for the action of DDT has not held up, neither has its model for the development of cancer. The assumption widely held in 1962, and since increased in stature, is that both a disruption of the genetic material and the intrusion of a cancer virus are involved in the beginning of a cancer "incident." The genetic material temporarily can be disrupted by a "carcinogenic" substance (which is probably the same thing as a "mutagenic" substance), and before the genes can be repaired, a virus (which is really nothing more than a set of "naked genes") become permanently linked into the long genetic molecule. One current theory, widely accepted, is that such cancerous "incidents" occur in the body every day, but most are destroyed by the body's immune system. Once in a great while, however, an invaded cell escapes detection and is able to survive, eventually multiplying into a cancerous growth. The participation of the immune system suggests that the body's general health can play a large part in preventing cancer, and there are many studies linking general malnutrition with the very high rates of cancer among some South African Bushmen and other Third World peoples. This suggests that one way to reduce cancer might be to feed people better, but this is an avenue environmentalism has chosen not to take.

Because of the mutation/virus-intrusion assumption, the hunt for industrial carcinogens has settled upon substances that cause mutations among laboratory organisms. The most recently developed method is the "Ames test," invented by Berkeley biologist Bruce Ames, which uses a highly specialized strain of bacteria that is very susceptible to mutations to measure mutagenic effect. DDT and other chlorinated hydrocarbons have been subjected to the Ames test, and the results show that they do *not* cause mutations. The only exception is toxaphene, which—ironically—is the only chlorinated hydrocarbon pesticide still in use. (Interestingly enough, Ames, who is a staunch environmentalist, disputes the results of his own test and says DDT is "one of the 10 percent of all carcinogens that our test doesn't catch," although it is hard to know how he has decided this. There is one other study, performed at the Epley Institute in Omaha, that showed that DDT causes a slight increase in liver tumors in mice, although not in rats or hamsters. The results of that test are still disputed, because the tumors disappear when DDT dosages are stopped, but Dr. David Clayton, who performed the test, says he is satisfied DDT is a "mild carcinogen.")

In addition, there is one more indication, known for many years, that DDT was not causing any noticeable increase in cancer. This is simply that, among the thousands and thousands of factory hands, pesticide sprayers, farm workers, and people in malaria-prone underdeveloped countries who have been heavily exposed over the course of thirty-five years, there has *never* been any indication of an increase in cancer, even among workers who suffered accidental exposure great enough to put them in the hospital. In the 1950s, volunteers ate large quantities of DDT in a series of tests and never suffered any adverse effects.

Most of these facts were known during the late 1960s when environmentalists were determined to show that DDT was a public health menace. To solve their problem, environmentalists invented a kind of philosophical game which stated that, although there was no evidence to show that DDT did cause cancer, it was *philosophically impossible* for anyone to show that it *couldn't* cause cancer. In part, this argument relied on the fact that many cancers take from thirty to forty years to show up after exposure to carcinogenic substances. But even where the evidence was weakest, the environmentalists maintained that their position was unassailable. William Butler, chief counsel for the Environmental Defense Fund, which led the attack on DDT between 1966 and 1972, repeats the argument today: "You can't prove a negative," he said when I called him in April. "You can't say something doesn't exist because there's always a chance that it does exist but nobody has seen it. Therefore you can't say something doesn't cause cancer because there's always the chance that it does cause cancer but it hasn't showed up yet. You can't prove a negative statement." Does that mean you can't prove that dragons don't exist? I asked him. "That's right, you can't say dragons don't exist."

Butler is absolutely right, of course, in strict logical terms. The problem is that the same argument applies to any other synthetic chemical that is introduced into the environment, including the "biological controls." Like DDT, the blunderbuss of environmental regulation has turned out to be a killer of freind and foe alike. But environmentalism has by no means learned its lesson from the experience. In fact, it is already looking around for new worlds to conquer. Armed with the assurance that only industrial chemicals are causing cancer, the environmental movement and the federal government are now preparing to do for the rest of American industry what they have already done for pesticides by trying to remove all carcinogens from the environment. Speaking like a Puritan schoolmaster calling the class to order, Gus Speth, member of the President's Council on Environmental Quality, recently announced on the *New York Times* op-ed page: "The recent controversy on the proposed Food and Drug Administration ban on saccharin treated us to a dangerous amount of hilarity about the high dosage levels used in animal tests, and demonstrated the prevalence of misunderstanding in this area." The truth is, he announced, that 1) there is "no safe level" of a carcinogen, and 2) laboratory-animals tests are a sure indication of whether a substance causes cancer in humans. "With one or possibly two exceptions, every chemical known to cause cancer in humans also causes it in animals," he concluded. The question, of course, is whether it works the other way around.

The National Academy of Sciences has made an effort to bring some rationality to the notion that we will be able to purge our world of every last trace of carcinogenic material. In 1973, it published a book entitled *Toxicants Occurring Naturally in Foods,* which noted that trace amounts of cancer-inducing chemicals occur naturally in many foods. Another survey of the literature by Dr. Russell S. Adams, Jr., of Penn State University, found that such common foods as rutabagas, tea, cabbage, turnips, peas, strawberries, and milk all contain traces of chemicals that either cause cancer or are closely related to chemicals known to cause cancer. Dr. Julius M. Coon, one of the authors of *Toxicants Occurring Naturally in Foods,* and retired chairman of the Department of Pharmacology at Thomas Jefferson University, Philadelphia, had this to say about the "no safe dose of carcinogens" doctrine when I called him in April:

"When people say there is no safe dose of a carcinogen, what they are saying is that we can't find a safe level so we have to assume that there is no safe level. But the statement that there is no safe dose of a carcinogen is not a valid scientific statement in any sense of the word. We are constantly surrounded by chemicals that may cause cancer, most of them perfectly natural. I think it's reaching for the stars to say we're going to eliminate all carcinogens from our environment. I think the inflation we've seen so far will be a drop in the bucket compared with what we'd see if they try to enforce this new law [the 1976 Toxic Substances Control Act]. We may not have enough well-trained toxicologists to perform the tests."

Yet there seems to be no limit to what the federal government is willing to do to indulge the fanatical concerns about what we eat, drink, and breathe. Not to be outdone by the EPA, the Food and Drug Administration has started enforcing new regulations that apply the same elaborate toxicological standards to *all new hybrid* varieties of crops that are developed in the genetic laboratories. The FDA is no less aware that these human inventions are "synthetics" and that they offer the same dire possibilities that we may at last be poisoning ourselves. This means that the entire centuries-old effort of improving breeds for greater yields and better disease resistance could easily drown in the same sea of red tape that has already suffocated the pesticide industry. The National Academy of Sciences' 1975 report on pest controls voiced considerable alarm about the FDA effort. Yet, fueled by the fanatical concerns about pesticide residues and other toxicant traces, the FDA is moving ahead, and even now the results seem predictable. The hubris of the people who tell us we can wipe the last traces of toxic and carcinogenic materials from our environment is the same hubris of the people who once told us we were going to be able to rid the world of insects by spraying ever-increasing amounts of DDT.

Nature herself has met many of the problems that now beset us, and she has usually solved them in her own successful way. Where man has been intelligent enough to observe and to emulate Nature he, too, is often rewarded with success.

Rachel Carson, *Silent Spring*

The more I examine the environmental movement, the more it seems like a kind of secular religion, with a decidedly Puritan strain. Like all religious movements, it draws its strength from what we *don't* know. It tries to hide in the cracks of our understanding, instilling us with the fear of what we haven't yet been able to learn from nature. Public anxiety about scientific experimentation is nothing new. Louis Pasteur's neighbors in Paris besieged the authorities to put an end to his work. Practically every major medical advance, from autopsies and dissections to vaccination and surgery, has met with suspicion—and sometimes violent opposition—from a large portion of the population. Such misgivings have always existed, and are not always ill-founded. But it is only when some deeply conservative organization such as the Church or environmentalism has orchestrated such fears that these anxieties become institutionalized and *all* scientific advance comes under suspicion. Only then do ordinary human fears about newness and invention start to play a decisive role in history.

I am not foolish enough to think that there will not be a solution to the problem of biological insect controls. The newspapers will discover the situation and soon a new "crisis" will be upon us. But what keeps nagging in the back of my mind in this great Age of Environmentalism is what we are going to look like a few years from now. Somehow it seems we are going to appear as a generation that was so obsessed with misgivings, so afraid of what we didn't—and couldn't—know, so anxious to point hysterical accusing fingers at one another, that we neglected to pick up and use the simple tools we had at hand. I have no doubt that someone will eventually use these tools. I only wonder if we will ever calm down enough to do it ourselves.

Ergot: the taming of a medieval pestilence

LEO VINING

■ Leo Vining, *a native of New Zealand, is a professor of biology at Dalhousie University in Nova Scotia. He has spent most of his professional career researching microbial biosynthesis and chemical microbiology under the auspices of the National Research Council of Canada. This research has earned him several awards.*

In this article, Vining tells us a success story in the history of technology. Ergot is a fungus that grows in the seed-head of grasses, including rye and other plants cultivated for food grains. During the Middle Ages it was the cause of many illnesses and death. In come cases of ergot poisoning "the victims burned with 'holy fire' and the extremities atrophied." In other cases the victims "became demented and violent." Since the true reason for such illness was unknown, it was considered a punishment from heaven.

Slowly, over the years, the benefits of ergot administered in small doses were discovered. That ergot is a fungus was established in 1853. Nevertheless, understanding of the medicinal powers of ergot remained highly fragmentary.

Today ergot is used to treat a wide range of conditions, including migraine, and the "holy fires" of the Middle Ages have been put out once and for all.

In the year 857 A. D., according to German chroniclers of that period, the population around Duisberg was ravaged by "a great plague of swollen blisters that consumed the people by a loathsome rot so that their limbs were loosened and fell off before death." The circumstances and description of this tragedy indicate that it was not another of the bacterial epidemics that we associate with the great plagues of the Dark and Middle Ages, but was, in fact, due to mass food poisoning. The cul-

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prit was ergot, a common but unrecognized contaminant in the food grains of those times.

A DESCRIPTION OF ERGOT

Ergot is a fungus. While we have no difficulty in recognizing food spoilage by the ubiquitous molds, which are also fungi, the spoilage caused by ergot is more subtly introduced and, through a combination of circumstances, remained undetected for centuries.

The ergot fungus in its natural habitat is a plant parasite. It grows on and is nourished by a living host, in contrast to the usual refrigerator molds which grow mostly as saprophytes, on dead tissue. Unlike the molds, ergot undergoes several changes in form and appearance during its annual life cycle. It grows in the seed-heads of grasses, including those that man has developed and cultivated for food grains, and replaces a normal seed. At the growth stage coinciding with harvest time for cereal crops, it masquerades as the grain it has replaced. This is the most commonly recognized form of ergot; it is also the form which contains a group of very potent chemical substances, called ergot alkaloids, which cause profound physiological effects if eaten. Without realizing it the farmers of earlier times were harvesting a mixture of grain and ergot with lethal properties.

Those who ate the bread baked from ergot-contaminated flour fell victim to any one of ergot poisoning's many forms. The most widespread symptom was a feeling of cold fire in the limbs—rather like the pins and needles sensation one experiences when circulation has been restricted. We know now that the ergot toxins constrict the blood vessels in the body to cause this effect. The sensation is agonizing and reduced circulation over prolonged periods also has the more severe effects of causing the affected limbs and tissue to atrophy. The contractive action of the toxins on smooth muscle can cause epileptic convulsions and, in addition, ergot has an hallucinogenic effect, inducing mental distortions and dementia. All of these symptoms develop when small quantities of bread containing ergot are eaten over an extended period. Eating large amounts is rapidly fatal, with any one of the symptoms dramatically prominent.

ERGOT: THE WRATH OF GOD

Ergot poisoning was rampant in Europe throughout the Middle Ages and did not disappear until comparatively recent times. Like the great bacterial plagues its real cause was not recognized, but the remarkable symptoms of ergot intoxication soon acquired for it a plausible explanation.

The French archivist Frodoard noted that in an outbreak around Paris in 945 A.D. some of the afflicted, who were cared for in Saint Mary's Church and fed wholesome rations provided by a benevolent Count Hugo, recovered. Those who returned home often found the fire in their bodies rekindled, and were taken again to the chapel to be healed by penitence and prayer. In the religious climate of the times the "fire" was attributed to divine punishment for sinful living, and the recovery to divine forgiveness. If anyone suspected a connection between recovery and the quality of Count Hugo's flour, Frodoard made no note of it.

In the period between 800 and 1500 A.D., historical records describe hundreds of "plagues" in which the symptoms match those of ergot poisoning—usually either the gangrenous form where the victims burned with "holy fire" and the extremities atrophied, or the convulsive kind where the victims became demented and violent. There are frequent references to single epidemics in which 40,000 to 50,000 people died during a year of suffering. The cumulative death toll is staggering: millions of people perished or survived as cripples, and entire regions were decimated. Coincidental events took on significance and the holy fire disease came to be known by many names.

Around Aquitaine in France an epidemic raged for months until the abbé had the bones of Saint Martial dug up and displayed to the sufferers. The pestilence ceased soon afterwards, probably because it was harvest time and the new grain was free of ergot, but in that region "ignis plaga" became "ignis Sancti Martialis." In another area where "holy fire" symptoms in the nose, mouth, and hands were especially prominent it was called "ignis judicialis"—a judgment on the debauchery of the inhabitants. The most common name, however, was "ignis Sancti Antonius"—Saint Anthony's fire. In 1090 the son of a rich nobleman in the Dauphinée region of France was afflicted. Kneeling before the bones of Saint Anthony, the father pledged his riches to help victims of the holy fire if his son were spared. When the son recovered the nobleman kept his promise by founding a series of hospitals throughout the country and Saint Anthony became the patron saint of all ''fires,'' epilepsies and eczemas.

Since food selection has been an important element of survival—only those of us whose ancestors were good at recognizing the poisonous from the non-poisonous are here today—ergot was clearly an insidious and deceptive toxin. In a large measure the deception was grounded in the religious beliefs of the early Middle Ages which provided such satisfying explanations for the symptoms of ergot poisoning. Ergot was widely known to midwives and physicians for its potent and toxic drug action. Historians frequently recounted the sufferings of afflicted people in areas where the crops had been bad and the bread of poor quality. And men of science had been interested in ergot as a disease of grain crops for many years. Yet none of those most familiar with ergot saw the connection between severe ergot infestations and subsequent outbreaks of the fire plague. It was left to an observant Paris lawyer, M. Dodart, whose work took him for several years on visits to the low-lying Sologne district of France where rye was the main cereal crop, to link the prevalence of Saint Anthony's fire with the high ergot content in grain ground by the millers.

THE CATCH IN THE RYE

Rye is a hardy plant. It was not used as a grain by the ancients but was introduced after Roman times into Europe where it thrived on the poorer and damp land unsuitable for wheat. Because of its affinity for infertile land, rye tended to be the grain of the poorer peasants. Reluctant to discard any part of their harvest, even the dark and distorted ''seeds'' of ergot which flourished in wet seasons, they would often harvest a large amount of ergot with their crop. Although they might set aside the most obviously contaminated grain, often by late winter even this would be used. Thus the severity of the fire plagues often increased thoughout the spring and summer. Interestingly, too, the monks who nursed the plague victims seeking atonement at the shrines of benevolent saints usually farmed the better lands on which wheat could be grown. Wheat is less prone to parasitism by the ergot fungus and the monks could better afford to clean their grain. The bread they provided for the pilgrims was of good quality and the plague victims found physiological as well as psychological relief from their suffering. Meanwhile, their confidence in divine intercession prospered.

Ergot poisoning may also have been mistaken for supernatural intervention on this continent in the early 17th century and triggered the Salem witch hunt. There is some evidence that the young girls who were believed to have been possessed by the devil may have been eating ergot-contaminated rye bread. Their initial behavior coincided in some respects with that of fire plague victims.

When Dodart reported his deductions about the cause of Saint Anthony's fire to the French Academy in 1676, he proposed that the government introduce laws requiring that all rye grains be sieved to remove ergot before being milled into flour. Strict controls were soon adopted in France, but outbreaks of ergot poisoning did not cease immediately. Peasants refused to believe that God would poison their crops and distrusted laws enacted by the authorities. In Russia there were severe epidemics even to the 20th century. During the winter of 1926-1927 11,000 people were stricken and 93 died. In France, bureaucratic control of the milling and distribution of flour eventually became too unwieldy and failed to prevent an outbreak of ergotism as late as 1951.

THE BIRTH OF SCIENTIFIC EVIDENCE

With the increase in scientific observation during the Renaissance, naturalists began to study and speculate about the nature of ergot without being in any way aware of its relationship to the ''holy fire'' disease. Thalius, a respected authority of the 16th century, considered it to be a malformed plant seed. The suggestion that ergot might be fungus did not surface until 1711, and was hotly disputed. In 1815 the French Academy commissioned one of their members to settle the issue. On the basis of a chemical analysis, Vauquelin declared it to be a seed! It was not until 1853 that the question was finally resolved by Tulasne, a biologist. He showed that the peculiar structure was only one stage in the lifecycle of a fungus—the stage that enables it to survive the winter in a dormant state.

At some point not recorded in medical history it was discovered that eating small quantities of ergot would hasten childbirth. Knowledge of this effect seems to have spread through the folklore of midwives, and the first written prescription for its use appeared in Adam Lonicer's *Krauterbuch* or herbal of 1582. Over the next 300 years ergot gradually found its way into most unofficial medical texts, usually with instructions that one to three "spurs" could be eaten if labor was slow or prolonged. It was introduced into the official pharmacopoeia in the 19th century largely because of the work of John Stearns, a New York state physician who experimented with ergot after hearing of its use from a local midwife. Stearns collected ergot from granaries in the neighborhood and compared the effects of extracts as well as powdered ergots. He found that the substance extracted with water was as active as the ergots themselves—a valuable drug, when properly used. The potency of the extract varied with the source of the ergot and the care with which it was prepared. Moreover, there was no convenient way of testing the activity before use. Overdoses produced severe toxic reactions and, as Stearns had warned, the action of the drug was so powerful and immediate that the uterus would rupture if the child had not been correctly positioned for delivery. By the end of the 19th century the use of ergot extracts to hasten childbirth was considered too dangerous and was discouraged in medical teaching. Instead, it was recommended for postpartum administration to contract the uterus and prevent hemorrhaging. Ergot drugs are routinely used for this purpose today.

THE BIOACTIVE INGREDIENTS IN ERGOT

For 100 years after John Stearns described the effects of an ergot extract chemists tried without success to purify the active principle. Their main difficulty was the lack of a simple, meaningful assay to test the different fractions obtained through purification, and their search tended to concentrate on discovering substances that had chemical resemblance to the higher plant alkaloids already known to be potent natural drugs. In 1918 this effort paid off with the isolation by Alfred Stoll at Sandoz laboratories in Switzerland of ergotamine, a pure alkaloid with many of the properties of the parent ergot. With this discovery a reliable ergot drug preparation became possible, but it took another 33 years before chemists could describe in precise terms the molecular structure of the compound.

One of the difficulties in isolating ergotamine was that it was hidden among several other very similar alkaloids. It soon became apparent that the activity of ergot is due not to a single substance but to a group of alkaloids. Additionally, these are rather unstable compounds which rearrange to inactive forms under some of the treatments routinely used in isolating natural products.

Examining the pharmacological activity of each pure alkaloid of the ergotamine type, chemists failed to match the rapid and powerful uterocontractive activity shown by crude ergot extracts. An English pharmacologist, L. Chassar Moir, devised a very direct way of measuring this activity by placing in the uterus a small water-filled balloon connected by tubing to a barometric recorder. With this as a bioassay and the help of a chemist he then isolated from ergot a new alkaloid. . . . Moir was not alone in his search for this compound: it was described by four different laboratories at about the same time. Thus the compound is variously known as ergometrine, ergobasine, ergonovine and ergostetrine. It is this compound and a semi-synthetic methylergobasine that are now used routinely in childbirth to minimize the chances of postpartum hemorrhage.

The semi-synthetic methylergobasine is prepared by treating the natural alkaloids with alkali to cleave the molecules into their components. The lysergic acid fragment is recovered and attached chemically to a new base (in this case butanolamine) to form methylergobasine. The semi-synthetic drug has similar but not identical uterocontractant activity to its natural homologue, ergobasine.

In the search for other semi-synthetic variants, Albert Hofmann in the Sandoz laboratories prepared many new alkaloids like methylergobasine. One of these produced startling effects, which he discovered in 1943 by accidental self-administration. The compound was a diethylamide of lysergic acid, LSD-25. Hofmann, abandoning laboratory work for the day, set off for home on his bicycle and later recalled his experience: "My field of vision swayed and objects appeared distorted, like images in curved mirrors. I felt fixed to the spot, although my assistant told me afterwards we were cycling at a good speed. I recall the most outstanding symptoms as vertigo and visual disturbance; the faces of those around me appeared as grotesque colored masks. I recognized my condition clearly and sometimes, as if I were an independent neutral observer, saw that I babbled half insanely and incoherently. Occasionally I felt out of my body. When I closed my eyes endless colorful, realistic and fantastic images surged in on me. Acoustic perceptions, such as the noise of a passing car, were transformed into optical effects, every sound evoking a corresponding colored hallucination constantly changing in shape and color.''

LSD is an extremely potent substance that produces its hallucinogenic effects by acting directly on the central nervous system. A dose of 1 to 2 μg per kg. body weight will usually elicit symptoms within a few minutes and in the range from 1 to 16 μg per kg. the intensity of the effect is proportional to dose. An immediate dizziness, weakness and nausea is usually followed by inner tension and, in the second or third hour, by visual illusions and sensory distortions. Loss of sensory boundaries creates a need for a supporting environment. Recollections from the past may overlap the present, while moods shift suddenly from elation to fear. If a major panic episode has not occurred after four to five hours, a sense of detachment and supreme control may arise. Although the half-life of the drug is about 3 hours, the entire syndrome usually lasts for about 12 hours. Because of the unpredictable incidence of ''bad trips'' which can neither be prevented nor treated, other than by reassurance in a supportive atmosphere, the use of LSD is considered by psychologists to be a hazardous undertaking, even though the extreme potency of the drug means that there is little risk of a toxic overdose causing the more clinically dangerous symptoms of ergot poisoning. The drug was used experimentally for a time to treat alcoholism and opiate addiction but caused no permanent change in psychological state. This use has been abandoned and LSD appears now to have no clinical value.

LSD is not a natural constituent of ergot, but related ergot alkaloids do possess similar, if much less intense, abilities. Ergine, the parent lysergic acid amide, is one such compound. Well known to chemists for many years as a degradation product of the more complex alkaloids, its psychotomimetic action was not discovered until 1961 when Sandoz became interested in the drugs used by Central American Indians in their religious ceremonies. *Ololinqui,* the seed of a species of morning glory native to Mexico, contained ergine as the active principle.

THE MODERN ERGOT PHARMACOPOEIA

Ergot alkaloids exhibit a remarkably wide range of physiological effects, all of which stem from actions on the nervous system. To various degrees, they affect the central nervous system directly and cause responses such as a drop in pulse rate, respiration and heart beat by depressing the vasomotor control center of the medulla. LSD, by far the most powerful central nervous system activator, appears to affect the transmission of signals mediated by 5-hydroxytryptamine at much lower concentration than other neurohumoral responses and thus produces a specific psychedelic action at very low doses.

Nerve impulses generated in the brain control the activities of the body through a series of parallel transmission systems. The ergot alkaloids act in the hypothalamic region of the brain which is the principal locus of integration for autonomic functions—those activities that are under involuntary control such as blood pressure, fluid balance, and the less mechanical responses of sleep, emotions and sexual reflexes. The hypothalamus also links the brain with its neural mode of transmission to the endocrine system which regulates body function through the use of chemical messengers (hormones) that travel in the blood stream to act on distant glands and tissues.

A study of pig mortality in Africa pinpointed the capacity of ergot alkaloids to interfere with this process. Death of newborn piglets caused by drying up of the sow's milk supply was traced to a high content of ergot in the millet supplied to the piggery. This effect was in turn traced to the action of agroclavine, a member of the ergot alkaloid group, which interferes with hypothalamic-mediated release of the hormone prolactin from the pituitary. Prolactin is required to induce milk secretion in the mammary glands. The action of agroclavine is mimicked by several semi-synthetic lysergic acid derivatives; such compounds, more active and less toxic than the natural alkaloid, are now in clinical trial for treatment of conditions such as galactorrhea (excessive milk production) and mammary carcinomas that depend on prolactin for continued growth.

During the studies on agroclavine that established its effect on prolactin release, it was observed that mice treated with the drug immediately following copulation failed to conceive. It is now known that the alkaloid and several semi-synthetic members of the group prevent pregnancy by interfering with implantation of the fertilized egg in the uterus. The activity is attributed to inhibition at the hypothalamus of necessary hormone factors essential for the proper development of pregnancy, and offers one potential route to the development of "morning-after" birth control.

The classic uterocontractive activity of ergot alkaloids is due to their effect in the peripheral system where the nerves stimulate or relax smooth muscle. They interfere with the action of noradrenalin, one of the chemical substances that connects nerve activity at synaptic junctions, and the blockade is manifest to varying degrees in alkaloids of different structural types. Most active are the alkaloids, such as ergotamine, which possess a peptide component. Their powerful constrictive action on blood vessels is the basis for their most widespread modern use, the treatment of migraine headaches. Ergotamine is the most effective compound and, so far, the only useful remedy. Migraine is believed to be due to increased amplitude of pulsations in the cranial arteries. The alkaloid, by constricting the arterioles, suppresses these pulsations. Relief is often instantaneous if the drug is injected into the bloodstream, but it is usually given by a less direct route. The dose regimen must be monitored carefully to avoid ergot poisoning.

MANUFACTURING ERGOT ALKALOIDS

Searching out and collecting ergot from naturally infected grasses and cereal crops has long ceased to provide the quantity needed to prepare pure drugs. The immediate solution to the supply problem was to develop ways of artificially infecting crops with the ergot fungus to obtain higher yields. Since ergot is worth 20 times as much as the grain it replaces this is a worthwhile proposition for a farmer, provided the fungus infestation can be contained. Rye is the crop of choice because of the relatively long period when the glumes are open and fungus spores can infect the rye ovary. Ergot cultivation is normally confined to isolated valleys, in fields surrounded by tall trees to prevent spore dispersal by wind and insects. At first, crops were sprayed during flowering with a water suspension of spores, but repeated applications were needed since the glumes do not all open at the same time. The technique was eventually superseded by directly injecting spores by a needle-puncture method. Tractors were fitted at the front with a device that pressed the seed heads between two moving belts, one of which carried a set of needles that had passed through a suspension of spores. A very heavy primary infection can be obtained in this way so that good yields do not depend on secondary dispersal by insects, wind and rain at the honeydew stage.[1]

Along with this kind of agrotechnical research went an empirical selection of genetic strains that gave superior yields of the desired alkaloids and less complicated mixtures to make isolation and purification easier. The overall effort was so successful that, until very recently, all ergot used by the pharmaceutical industry was produced in this way. However concurrent with research into field production methods an alternative approach aimed at achieving production of the alkaloids by cultivating the fungus in tanks of artificial media was developed. This process is now displacing field cultivation as the more economical and reliable method.

The ergot fungus can be grown easily in the laboratory, but most early attempts to persuade it to produce ergot alkaloids in artificial culture were unsuccessful. Where production was achieved the yields were invariably low. To overcome this problem, Matazo Abe in 1948 screened many hundreds of fungus isolates from ergot growing on wild Japanese grasses until he found strains that yielded well when cultivated in a simple nutrient solution. Surprisingly, however, the alkaloids formed by these strains were different from ergotamine and the other alkaloids previously isolated from natural ergot. The main product in his first culture was aproclavine. Over the next ten years

[1]The life-cycle of ergot provides for reproduction and dispersal in appropriate seasons. The ergot body falls to the ground in late fall and germinates in late spring; this sequence of winter cold followed by spring moisture and warmth are necessary to break dormancy. The germinating ergot produces numerous finger-like outgrowths that develop heads packed with threadlike spores. These are dispersed by wind or carried by bees and other insects to the flowering heads of grasses. A fungus spore landing in the open floret grows on the ovary, eventually consuming it. Filamentous cells proliferate, followed by a "honeydew" stage when filaments exude a sweet, sticky liquid containing masses of small round asexual spores. These are carried by the many kind of insects that feed on honeydew to other plants, spreading the infection widely. After the honeydew stage, the fungus produces a core of closely packed cells which expands to form the ergot body. This core preserves the fungus in a dormant state during the winter and it alone contains the poisonous alkaloids.

dozens of similar alkaloids were found, but none of the high-yielding cultures produced clinically useful compounds.

The first break came in 1960 when an Italian group working with Ernest Chain found a strain of *Clavicaps paspali*, a species of the ergot fungus growing on paspalum grass, that produced large amounts of the hitherto unknown alkaloid, lysergic acid α-hydroxyethyl amide, in culture. This can be easily hydrolyzed chemically to lysergic acid and converted to the clinically useful ergometrine or methylergobasine. A few years later workers at the Sandoz laboratories in Basel discovered a subspecies of *Claviceps paspali* that produced high yields of paspalic acid, an alkaloid easily rearranged to lysergic acid. This process, too, became a starting point for the semi-synthetic production of uterocontractant alkaloids. Persistent research has gradually solved the riddles of ergot fungus physiology and even the recalcitrant *Claviceps purpurea* has now been persuaded to make large quantities of the valuable ergotamine in culture. Once reasonable yields are obtained the inherent advantages of fermentations over field cultivation make the choice between these processes a simple one.

THE RAISON D'ETRE FOR ERGOT ALKALOIDS

With Saint Anthony's fire eradicated and the scourge of medieval peasants and villagers now producing useful drugs for mankind, one intriguing question remains: what possible use can the ergot alkaloids have in the fungus that makes them? We cannot arrive at a decisive answer since proof is hard to come by, but consider these facts:

The genetic and biochemical machinery needed to make these compounds is complex, and therefore expensive for the fungus to maintain.

Unnecessary characters are normally lost during the evolutionary struggle for survival.

There seems to be a link between the ability of the fungus to parasitize plants and to produce alkaloids.

The ergot bodies are dark-colored and therefore visible as well as toxic, so that predators, especially birds, would learn to avoid them.

It seems reasonable to believe that formation of alkaloids is a protection for the unusual lifestyle of the fungus. Unfortunately man, through reasons of his own making, took an exceptionally long time to discover that ergot was not edible and should be strictly avoided.

Ergot is a word of French origin meaning "cockspur." The German name is *Mutterkorn*, a folklore term that was adopted when the cornfields were believed to be visited by a demon spirit, the corn mother. The corn could be seen to sway and part as she passed through; where she touched the seed heads *Wolfzähne*, sprang up, intended for her children, the rye-wolves. It seems we have always tried as best we can to explain away the things we don't quite understand. We may no longer believe that ergot is made by a demon spirit to provide teeth for her children but perhaps our present attempt to explain its existence may prove to be no less fanciful.

Technology and the biomedical sciences

The future impact of science and technology on medicine

LEWIS THOMAS

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In the following article Thomas discusses the three levels of technology involved in modern medicine. He calls the first and highest level "high technology." "This is the genuinely decisive technology of modern medicine exemplified best by methods of immunization against . . . various virus diseases, and the contemporary use of antibiotics and chemotherapy for bacterial infections." The important feature of high technology is that it is the result of a genuine understanding of disease mechanisms. The second level of technology he calls "halfway technology." Exemplified by transplants and the invention of artificial organs, this kind of technology is an attempt to compensate for the effect of disease which we do not yet know how to control. The third and lowest level of technology is best termed "non-technology." It is basically "caring for" and "standing by" the patient when no known technology can be used to help him.

Lewis points out that the last two levels are the most expensive. In times when money is becoming scarce, he suggests that it would be wise to put most of the money where it can produce the best results, namely in basic science research. If the mechanism of a disease becomes understood, the expensive units designed to compensate for the damage resulting from the disease become unnecessary. The need for non-technology would also be substantially reduced.

It is said that we are spending this year something like $85 billion on health in this country. Last year the figure was $70 billion; the year before around 60. Nobody can vouch with certainty for the accuracy of these figures, nor even count up all the things the dollars are presumably buying. But no matter; they are socking great sums, enough to warrant the term Health Industry for the whole enterprise.

With an investment of this size, much of it representing public funds, it is surprising that there is so little analytical information concerning the enterprise; there is really no such thing as a Health Policy for the country in the sense that the term Policy is used for other major public ventures and certainly nothing like real Policy Planning. There is only an intense public anxiety that it is costing much too much money and we cannot afford to put in more; also, there is a spreading doubt that we are getting anything like our money's worth.

In this climate, it is no wonder that the general support for scientific research and training in the biomedical sciences has come upon such hard times in the past several years. This, by the way, is not a special bias of the present administration. The cutting back on funds to support medical research began in 1967 and would probably have continued regardless of what administration took power. There is an unmistakable loss of confidence in the value and effectiveness of science. It applies to science in general, not just medicine. It derives in part from the anxiety about our mixed technological blessings and some general apprehension about the future. At the same time, doubts have arisen about the capacity of science to solve our health

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problems and there are new fears concerning the harmful effects of science in medicine. We are suspected of busying our laboratories devising hideous new technologies to engineer ordinary, friendly, everyday man out of existence. We have special basement laboratories where we invent ways to control human behavior to our liking, transplant heads, raise identical parthenogenetic babies in plastic test tubes, clone prominent political figures, and teach computers to think rings around us. Scientists, in short, are suspected of having gone crazy—partly, it is also suspected, under the influence of money.

These are bad times for reason, all around. Suddenly, all of the major ills are being treated by acupuncture. If not acupuncture, it is apricot pits, astrology, or transcendental meditation.

We are in danger of losing sight of our genuine assets and in even more danger of failing to take advantage of the opportunities in science which, in the long history of science, have never been so real. There is, not too far ahead, the solid possibility that man may be rid of the worst of his diseases once and for all. This is a time when we ought to be making very careful plans for the long-term future. It is the unlikeliest of all times for us to be getting ourselves into a depression about medical science.

What we need today in medicine is a better technology assessment—the same kind of periodic hard-headed assessment of technology that has become a routine and profitable exercise for most of the large industrial enterprises of the nation. We need an inventory of our information, our methods, and our real prospects for the future. Up to now medicine has received very little of this kind of treatment. The technology of medicine has simply been accepted as given—as something there, for better or worse, to be taken for granted. Even the term "technology" means something different to most people from what it means to the rest of science. We are not accustomed to thinking of antibiotics, insulin, or coronary bypass surgery as the items of technology they obviously are, and we tend to speak of technology only in the sense—and a very limited sense it is—of the methods involved in the distribution and delivery of health care.

It would be useful, I think, to take a careful look at the actual measures employed in the management of disease and the preservation of health, and to make, periodically, the same objective appraisals of their effectiveness as are made by other industries. It would be a lot easier to work out long-range policies, set future goals, and assign budgets if we had some system in operation to tell us, at any given moment, where we stand with our technology, what these measures are costing us, and whether there are options in sight, especially whether there is new information that might lead to basic changes in technology just ahead.

We have no such system for appraisal. There are good reasons for this although I believe the time has come for us to find our way around the difficulties. The technology of medicine has certain features that distinguish this field from the rest. One difference has to do with the economics which seem to govern all other technological advances but have no discernible influence on the kinds of things we do, or *think* we do, in medicine. For example, we do not build new bridges at great cost without knowing in advance, quite precisely, what the transport requirements will be in the future, and having some kind of assurance that the bridges will bear the traffic, meet all forseeable demands and stand up to all forseeable stresses. But we will undertake the development of an artificial heart at the cost of many bridges without going through any sort of cost-benefit, logistic, or even moral analysis of what it is that we are making. Indeed, in medicine, it is characteristic of our technology that we do not count the cost, ever, even when the bills begin coming.

This is plainly a defect in our system—if we can be said to have a system. It is, in part, explainable by our history, by the brand newness of any kind of technology at all in this field, and our consequent unfamiliarity with any methods, or indeed, any incentive in the first place, for technology assessment in medicine. We have had almost no genuine science to tap into for our technology until just the past three decades. As a profession, we go back a very much longer time, probably thousands of years. During most of our history, therefore, we have become accustomed to no technology, or to pseudotechnologies without science. We have long since acquired the habit of improvising, of trying whatever came to hand; and in this way, have gone through our cyclical fads and fashions, generation after generation, ranging from bleeding, cupping, and purging, through incantations and the reading of omens, to prefrontal lobotomy and metrazol convulsions; we have all gotten quite used to this kind of thing, whether we will admit it or not. Early on we became accustomed to the demand that a doctor must *do* something; doctors who didn't *do* something, no matter what, were not real doctors. During the long period when we knew of nothing to do about typhoid fever except to stand by and wait for the patient to struggle through, keeping an eye out for the hemorrhages and perforations that might kill him at any time, the highest level of technology was the turpentine stupe. This was an elaborate kind of fomentation applied to the belly, very difficult to make without ending up with a messy shambles, and capable, I believe, of doing absolutely no good whatever beyond making everyone feel that the doctor was *doing* something. This, by the way, is not a baroque item of our distant history. I learned to make a turpentine stupe at the Peter Bent Brigham Hospital in 1937; it is, therefore, in my view, a relatively recent, almost modern example of the way we develop technology, and it is not yet all behind us as we shall see. We still have our equivalents of bleeding, cupping, and turpentine stupes, and they are all around us.

The trouble with this kind of pseudo-technology or magical technology is that it has become unbelievably expensive in its more modern forms, and, at times, is dangerous. It is particularly dangerous and expensive when it takes the form of strong drugs, bizarre diets, or surgery.

But now that science has entered medicine in full force, we must begin to sort out our affairs. From now on we will need, as never before, to keep the three central enterprises of medicine—"to cure, to relieve, to comfort"—clearly separated from each other in our minds. They do not really overlap, but we tend to view them, and the public takes the same view, as though they were all of a piece, all the same body of technology, all derived from science, all modern. I think perhaps one reason we do this is because of an unconscious conviction that dollar values must be placed on all human enterprises, and we do not like to confess to ourselves that so many of the things that we do are simply provided for comfort and reassurance. Somehow this has come to seem a less significant product than a cure; so we try, consciously or unconsciously, to pretend that there is more continuity than is really there, that everything we do is directed toward the same end.

In fact we are engaged in three entirely different kinds of technology in medicine. I have an idea that if we could conduct a sort of technology assessment on ourselves, and come to some sort of general agreement about which technology belongs in which category, we might be in a better position to make intelligent plans and forecasts for the future. We would almost surely be clearer in our minds about how to set priorities for the investment of scientific resources for the future.

Before beginning on my own version of a classification, I would like to make a general declaration of faith, and a general confession of optimism. My dogmas are as follows: I do not believe in the inevitability of disease. I concede the inevitability of the *risk* of disease, but I cannot imagine any category of human disease that we are precluded, by nature, from thinking our way around. Moreover, I do not believe that when we succeed in controlling or curing one kind of disease we will necessarily, automatically, find that it has been replaced by another.

Even if I am wrong, and it should turn out that there is some law of nature that mandates the doling out of new diseases up to some optimal number whenever old ones disappear (which strikes me as a piece of illogic as well as high improbability), I still cannot imagine remaining helpless before all the new ones. Nature is inventive but not so inventive as to continue elaborating endless successions of new, impenetrable disease mechanisms. After we have learned enough to penetrate and control the mechanisms of today's disease, I believe we will be automatically well-equipped to deal with whatever new ones turn up. I do not say this in any arrogance; it just seems reasonable.

I have no more difficulty in imagining a disease-free human society, or at least a society in which major diseases are held under control, than I do with the idea that valuable stocks of animals, or varieties of plants, can be maintained *relatively* free of disease.

I believe that disease is fundamentally unnatural. It is not a normal or natural part of the human condition for aging human beings to become paralyzed and idiotic for long years before they finally die any more than it is for young people to develop acute leukemia. I believe that disease comes generally as the result of biological mistakes: misinterpretations of signals on the part of cells and tissues; misuse of information. I believe that the mechanisms of disease are quite open to intelligent intervention and reversal whenever we learn more about how they operate.

To say it another way, I do not consider that the ambition to control or eliminate disease, which is an ambition shared by everyone in biomedical science, is either unthinkable or any distance beyond imagining. What makes it seem to many people like an outlandish, even outrageous way to be talking, is that it becomes assumed that we are talking about human happiness, which is really quite another matter, or about human mortality, which is also quite another matter. As to the first, it is of course true that disease has long been a major cause of human despair and wretchedness, but this is no reason to believe that we will all become happy, well-adjusted people by being rid of it. We will still be left with our share of worrisome problems, and we will still have more than our share of ample reasons for despair, and no medical science—not even psychiatry—has any forseeable contribution to make to these matters. War and bombs, failure and anomie, clouding of the sun by particles of our own waste, the shutting off of oxygen, the loss of room to move around—these are problems still to be with us for some time to come, healthy or ailing, and I hope that no one will suggest that these are in any sense problems for medicine—or we will never get any of them solved. But perhaps human society will be better equipped to think its way through these imponderables if, at least, we no longer have today's roster of diseases to worry us at the same time.

As to mortality, I have a hunch that we will discover, someday, that disease and death are not as inextricably interrelated as we tend to view them today. All the rest of nature undergoes, in its variable cycles, the physiological process of death by the clock; all creatures, all plants, age finally, and, at the end, they all die. Diploid cells in tissue culture have finite life spans which are different for different lines of cells, and characteristic of particular cell stocks. Some live for 40 generations and then die; others for 70. They do not develop fatal diseases; it is not a catastrophe—they simply reach the end of a life-span programmed for them in their own genomes, and at the end of that span, they die.

I believe that we are also like this. If we are not struck down prematurely by one or another of today's diseases, we live a certain length of time and then we die, and I doubt that medicine will ever gain a capacity to do anything much to modify this. I can see no reason for trying, and no hope of success anyway. At a certain age, it is in our nature to wear out, to come unhinged and to die, and that is that. My point here is that I very much doubt that the age at which this happens will be drastically changed for most of us when we have learned more about how to control disease. The main difference will be that many will die in relatively good health, in a manner of speaking. Rather after the fashion of Bertrand Russell, we may simply dry up and blow away.

Even if our technology were to become so dazzlingly effective as to rid us of all the major diseases that now kill many of us before our time of wearing out, I doubt that the resulting population increase would make more than a marginal difference to the general problem of world overpopulation. Indeed, it might help some since there would be smaller numbers of us in hospitals, or living out their lives in various degrees of incapacitation and suffering. Being overpopulated is bad enough as social problems go, but to be overpopulated with so many disabled by disease, especially by the chronic diseases of the elderly let alone schizophrenia, presents an unthinkable prospect for the approaching century.

In any case, we do not really owe much of today's population problem to the technology of medicine. Overpopulation has been coming for several centuries and the alarming upward slope began long before we had developed a genuine capacity to change the outcome of disease. Modern medical science is a recent arrival and the world population had already been set on what seems to be its irreversible course by the civilizing technologies of agriculture, engineering, and sanitation—most especially the latter. From here on the potential benefits of medicine greatly outweigh any conceivable hazard. We will perhaps change slightly the numbers living at any moment in time, but it lies within our capacity to change very greatly the quality of life.

Well, where do we stand today as a science? This is not the same question, of course, as the one concerning the state of our technology. Our science is the science of the biological revolution, and we have scarcely begun to apply any of it. We do not yet, in fact, know where to begin. In contrast with today's genuinely high technologies of molecular biology, neurobiology, or cellular biology, with the immense power of their instruments for exploring the most fundamental questions about the processes of life, the condition of our knowledge of disease mechanisms has a primitive, 19th century look, and our capacity to intervene in disease is not much better. This is the general shape of things today, but tomorrow will be very different indeed. I simply cannot imagine any long persistence of our ignorance about disease mechanisms in the face of all that is being learned about normal cells and tissues. Our time for the application of science on a major scale is approaching rapidly, and medicine will be totally transformed when it happens. The hard problem just ahead will be setting priorities and making choices between options. We will be obliged, as never before in our history, to select alternative possibilities in technology; we will be compelled to make long range predictions as to the outcome of this course or that. In short, we will be thrust into the business of technology assessment just like all the other great national enterprises.

It is a curious position that we are in today, poised as we are between the old world of trial-and-error empiricism, superstition, hunch, and resignation to defeat, and the new world, just ahead, of hard information and applied science. We seem to work, as of now, with three different levels of technology.

1. First, and necessarily foremost, is what might be termed the *high technology* of medicine, equivalent in its sophistication and effectiveness to the high technologies of the physical sciences. It is a curious fact that although the accomplishments here represent the major triumphs of medicine to date, most of us tend to take them for granted. We often forget what they mean for the quality of life in modern society. This is the genuinely decisive technology of modern medicine exemplified best by methods for immunization against diphtheria, pertussis, and various virus diseases, and the contemporary use of antibiotics and chemotherapy for bacterial infections. The capacity to deal effectively with syphilis and tuberculosis represents a milestone in human endeavor, even though full use of this potential has not been made. And there are, of course, other examples: the treatment of endocrinologic disorders with appropriate hormones, the prevention of hemolytic disease of the newborn, the treatment and prevention of various nutritional disorders, and perhaps just around the corner the management of Parkinsonism and sickle-cell anemia. There are other examples and everyone will have his favorite candidates for the list; but the truth is that there are not nearly as many as the public has been led to believe.

The point to be made about this kind of technology—the real high technology of medicine—is that it comes as the result of a genuine understanding of disease mechanisms and, when it becomes available, it is relatively inexpensive, relatively simple, and relatively easy to deliver.

Offhand, I cannot think of any important human disease for which medicine possesses the capacity to prevent or cure where the cost of the technology is itself a major problem. The price is never as high as the cost of managing the same disease during the earlier stages of ineffective technology. If a case of typhoid fever had to be managed today by the best methods of 1935, it would run to a staggering expense. At say around 50 days of hospitalization requiring the most demanding nursing care, with the obsessive concern for details of diet that characterized the therapy of the time, with daily laboratory monitoring and, on occasion, surgical intervention for abdominal catastrophe, I should think $10,000 would be a conservative estimate for the illness as contrasted with today's cost of a bottle of Chloramphenicol and a day or two of fever. The technology that was evolving for poliomyelitis in the early 1950's, just before the emergence of the basic research that made the vaccine possible, provides another illustration. It is the cost of those kinds of technology and their relative effectiveness that must be compared with the cost and effectiveness of the vaccine.

Pulmonary tuberculosis had similar episodes in its history. There was a sudden enthusiasm for the surgical removal of the infected lung tissue in the early 1950's, and elaborate plans were being made for new and expensive installations for major pulmonary surgery in tuberculosis hospitals. Then, the drug isoniazid and the antibiotic streptomycin were discovered and the hospitals were closed.

It is when physicians are bogged down by their incomplete technologies and by the innumerable tasks they are obliged to do in medicine when they lack a clear understanding of disease mechanisms, that the deficiencies of the health care system are most conspicuous.

2. This brings me to the second level of technology in this classification, which I have termed the *halfway technology* of medicine. This represents what must be done after the fact in efforts to compensate for the incapacitating effects of certain diseases whose courses about which we are unable to do very much. It is a technology designed to make up for disease or to postpone death.

The outstanding examples in recent years are the transplantations of hearts, kidneys, livers, and other organs, and the equally spectacular inventions of artificial organs. In the public mind, this kind of technology now seems like the equivalent of the high technologies in the physical sciences. The media tend to present each new procedure as though it represented a breakthrough and therapeutic triumph instead of the makeshift that it really is.

In fact, this level of technology is, by its nature, at the same time highly sophisticated and profoundly primitive. It is the kind of thing that we must continue to do until there is a genuine understanding of the mechanisms involved in disease. In chronic glomerulonephritis, for example, a much clearer insight will be needed into the events leading to the destruction of capillaries in the kidneys. There is solid evidence that abnormal immunologic reactions are the basis for this destruction. If more information can be obtained, it should become possible to intervene intelligently to prevent the process, or turn it around. When this level of understanding has been reached, the technology of kidney replacement will not be much needed and should no longer pose the huge problems of logistics, cost, and ethics that it poses today.

An extremely complex and costly technology for the management of coronary heart disease has evolved involving specialized ambulances and hospital units, all kinds of electronic gadgetry, and whole platoons of new professional personnel to deal with the end results of coronary thrombosis. Almost everything offered today for the treatment of heart disease is at this level of technology, with the transplanted and artificial hearts as ultimate examples. When enough has been learned to know what really goes wrong in heart disease, we ought to be in a position to figure out ways to prevent or reverse the process, and when this happens the current elaborate technology will be set to one side.

The impending development of an artificial heart illustrates the kind of dilemma we are placed in by today's emphasis on halfway technology. Let us assume that heart disease, for all its manifold origins and its complexity, does represent an approachable scientific problem—that if we study the matter with sufficient imagination and energy, making use of all the new information about muscle structure and function and blood coagulation and lipid metabolism, and making capital use of new information along other lines as yet unguessed by any of us, we will eventually solve this problem and we will then learn how to intervene before the onset of irreversible muscle or valve disease, to prevent the process, or to turn it around. As a non-cardiologist, an outsider, I have total confidence that this can be done, that sooner or later it will be done, and my colleagues who know a lot about heart disease have, I sense, this same kind of confidence for the long term. This, then, is one option, and an altogether wise one to adopt. But the artificial heart represents a completely different attitude, basically opposed. To be willing to invest the many millions of dollars that will probably be necessary for this one piece of new technology almost demands of its proponents the conviction that heart disease represents an unapproachable, insoluble biological problem. It assumes that the best we will be able to do, within the next few decades, is to wait until the underlying mechanisms of heart disease have had their free run, until the organ has been demolished, and then to put into the chest this nuclear-powered, plastic-and-metal, essentially hideous engine. Even if it works, which I am afraid is not at all unlikely, I cannot imagine how society will solve the problems of cost, distribution, and priority. Who will be entitled to buy and have installed these engines—those with enough wealth to pay for them?—those who strike the rest of us, or our committees, as potentially useful citizens? Once we have started on this endless line of unsoluble problems, there may be no turning back. If ever there were an urgent, overwhelmingly important problem in biomedical science, it is with us now: someone simply *must* provide us with a quick solution to the problem of coronary atherosclerosis. If this can be done, the artificial heart can become, overnight, an interesting and ingenious contraption, something clever and decorative but no longer a practical thing, with some of the charm of a Tiffany lamp—a sort of instant antique, and we will all be the better off for this transformation. Otherwise, we are in for real trouble, just ahead, and I'm not sure we have the collective intelligence in medicine to deal with it.

Much of what is done in the treatment of cancer, by surgery, irradiation and chemotherapy, represents halfway technology, in the sense that these measures are directed at the existence of already established cancer cells, but not at the mechanisms by which cells become neoplastic. The policy problems that confront us now, with the nation's declared commitment to conquer cancer, are somewhat like those involved in the artificial heart question. There will be, for a while, anyway, a running argument between two opposing forces. There will be, on one side, those who believe that cancer is a still unsolved but eminently approachable scientific puzzle, requiring only enough good research by imaginative investigators, on a broad enough biological base. Provided with enough financial support and enough time, we will find ourselves home and dry. On the other side, there will be those who believe themselves to be more practical men of the real world, who feel that we have already come as great a distance toward understanding cancer as we are likely to move for some time. These men think we should give the highest priority to applying, on a much larger scale, what we know today about this disease—that with surgery, chemotherapy, and radiation we can now cure or palliate a considerable number of patients, and what we need at this time is more and better technology of essentially today's model. I do not know how this argument will come out, but I believe it is to be an issue of crucial, symbolic significance; whichever way it goes, it is possible that this will be the drift of biomedical science for the next decade. Personally, I would prefer the middle ground, for I like a comfortable position, but I am afraid that I belong with the first group of extremists in this one—for I regard cancer as an entirely open, entirely unsolved problem, wide open to research, and soluble, and I regard the technology of today's forms of therapy as paradigms of halfway technology, directed at the end-results of the disease rather than at underlying mechanisms.

It is characteristic of this kind of technology that it costs an enormous amount of money and requires a continuing expansion of hospital facilities. There is no end to the need for new, highly trained people to run the enterprise. And there is really no way out of this, at the present state of knowledge. If the installation of specialized coronary care units results in the extension of life for only a few patients with coronary disease (and there is no question that this technology is effective in a few cases), it seems to me an inevitable fact that as many of these as can be built will be put together, and as much money as can be found will be spent. I do not see that anyone has much choice in this. We are obliged, by the very nature of our professional responsibility, to adopt a new technology that will benefit patients with otherwise untreatable diseases, even when only a very small percentage will be benefitted, even when the costs are very high. Neither we, nor any other sector of our society, control this aspect of our economy. We cannot, like other industries, withhold a technology from the marketplace because it costs too much money or benefits too small a percentage of patients. The only thing that can move medicine away from this level of technology is new information, and the only imaginable source of this information is research.

The best we can do when the economic or logistic problems associated with our technology verge on the unsupportable, or when the odds are too high against the success of our procedures, is to try to improve the technology or to discover an altogether new technology as quickly as possible. Meanwhile, however, we must continue to employ the less than satisfactory ones.

3. This brings me to the third level of technology—the large body best termed *non-technology*. It is, in effect, the substitute for technology which medicine has always been compelled to use when we are unable to alter either the natural course of disease or its eventual outcome. A great deal of money is spent on this. It is valued highly by the professionals as well as the patients and consists of what is sometimes called "supportive therapy." It tides patients over through diseases that are not understood by and large. It is what is meant by "caring for" and "standing by," and is absolutely indispensable. It is not, however, a technology in any real sense.

It includes the large part of any good doctor's time that is taken up with simply providing reassurance, explaining to patients who fear that they have contracted one or another lethal disease that they are, in fact, quite healthy.

It is what physicians used to be engaged in at the bedside of patients with diphtheria, meningitis, poliomyelitis, lobar pneumonia, and all the rest of the infectious diseases that have since come under control.

It is what physicians must now do for patients with intractable cancer, severe rheumatoid arthritis, multiple sclerosis, stroke, and advanced cirrhosis. One can think of at least 20 major diseases that require this kind of supportive medical care because of the absence of an effective technology. In this category I would include a large amount of what is called mental disease and most varieties of cancer.

The cost of this nontechnology is very high and getting higher all the time requiring not only a great deal of time but also very hard effort and skill on the part of physicians. Only the very best of doctors are good at coping with this kind of defeat. It also involves long periods of hospitalization, a great deal of nursing, and involvement of non-medical professionals in and out of the hospital. It represents, in short, a substantial segment of today's expenditures for health. It is not as great a financial problem for the future as halfway technology, but between them, non-technology and halfway technology will sooner or later drive any system of health care that we may devise into bankruptcy.

If I were a policy-maker interested in saving money for health care over the long haul, I would regard it as an act of prudence to give high priority to a lot more basic research in biological science. This is the only way to get the full mileage that biology owes to the science of medicine even though it seems, as it used to be said in the days when the phrase still had some meaning, like asking for the moon.

Finally, I'd like to make a brief comment on biomedical science planning. This is an especially lively topic at the moment because of the immediate implications for national science policy. It is administratively fashionable in Washington to attribute the delay of applied science in medicine to a lack of systematic planning. Under a new kind of management, it is said that with more businesslike attention to the invention of practical applications we should arrive at our targets more quickly and, it is claimed as a bonus, more economically. Targeting is the new word. We need more targeted research, more mission-oriented science. And maybe less basic research—maybe considerably less. This is said to be the new drift.

One trouble with this view is that it attributes to biology and medicine a much greater store of usable information with coherence and connectedness than actually exists. In real life, the biomedical sciences have not yet reached the stage of any kind of general applicability to disease mechanisms. In some respects we are like the physical science of the early 20th century, booming along into new territory but without an equivalent for the engineering of that time. It is possible that we may be on the verge of developing a proper applied science, but it has to be said that we don't have one yet. The important question before the policy-makers is whether this should be allowed to occur naturally as a matter of course, or whether it can be ordered up more quickly under the influence of management and money.

There are risks. We may be asking for more of the kind of trouble with which we are already too familiar. There is a trap here that has enmeshed medicine for all the millenia of its professional existence. It has been our perpetual habit to try anything on the slimmest of chances, the thinnest hopes, empirically and wishfully. We have proven to ourselves over and over again that the approach doesn't work well. There is no question about our good intentions in this matter; we all hanker, collectively, to become applied scientists as soon as we can—overnight, if possible.

It takes some doing, however. Everyone forgets how long and hard the work must be before the really important applications become applicable. The great contemporary achievement of modern medicine is the technology of controlling and preventing bacterial infection, but this did not fall into our laps with the appearance of penicillin and the sulfonamides. It had the beginnings in the final quarter of last century, and decades of the most painstaking and demanding research were required before the etiology of pneumonia, scarlet fever, meningitis, and the rest could be worked out. Generations of energetic and imaginative investigators exhausted their entire lives on the problems. It overlooks a staggering amount of basic research to say that modern medicine began with the era of antibiotics.

We have to face, in whatever discomfort, the real possibility that the level of insight into the mechanisms of today's unsolved diseases—schizophrenia, for instance, cancer, or stroke—may be comparable to the situation for infectious disease in 1875, with similarly crucial bits of information still unencountered. We could be that far away in the work to be done, if not in the years to be lived through. If this is the prospect, or anything like this, all ideas about better ways to speed things up should be given open-minded, close scrutiny.

Long-range planning and organization on a national scale are obviously essential. There is nothing unfamiliar about this; indeed, we've been engaged in a coordinated national effort for over two decades through the established processes of the National Institutes of Health. Today's question is whether the plans are sharply focussed enough, the organization sufficiently tight. Do we need a new system of research management, with all the targets in clear display, at which we should aim?

This would seem reassuring and tidy. There are some important disease problems where it has already been done effectively demonstrating that the direct, frontal approach does work. Polio is the most spectacular example. Once it had been learned (from basic research) that there were three antigenic types of virus and that they could be abundantly grown in tissue culture, it became a certainty that a vaccine could be made. Not to say that the job would be easy, or in need of any less rigor and sophistication than the previous research; simply that it could be done. Given the assumption that experiments would be carried out with technical perfection, the vaccine was a sure thing. It was an elegant demonstration of how to organize applied science and for this reason it would have been a surprise if it had not succeeded.

This is the element that distinguishes applied science from basic. Surprise is what makes the difference. When you are organized to apply knowledge, set up targets, and produce a usable product, you require a high degree of *certainty* from the outset. All the facts on which you base protocol must be recognisably hard facts with unambiguous meaning. The challenge is to plan the work and organize the workers so that it will come out precisely as predicted. For this, you need centralized authority, elaborately detailed time schedules, and some sort of reward system based on speed and perfection. But most of all you need the intelligible basic facts to begin with, and these must come from basic research. There is no other source.

In basic research, everything is just the opposite. What you need at the outset is a high degree of *uncertainty;* otherwise it isn't likely to be an important problem. You start with an incomplete roster of facts, characterized by their ambiguity; often the problem consists of discovering the connections between unrelated pieces of information. You must plan experiments on the basis of probability, even bare possibility, rather than certainty. If an experiment turns out precisely as predicted, this can be very nice, but it is only a great event if at the same time it is a surprise. You can measure the quality of the work by the intensity of astonishment. The surprise can be because it *did* turn out as predicted (in some lines of research, one percent is accepted as a high yield), or it can be confoundment because the prediction was wrong and something totally unexpected turned up, changing the look of the problem and requiring a new kind of protocol. Either way you win.

I believe, on hunch, that an inventory of our major disease problems based on this sort of classification would show a limited number of significant questions for which the predictable answers carry certainty. It might be a good idea, when Commissions go to work laying out long-range plans for disease-oriented research, for these questions to be identified and segregated from all the rest, and the logic of operations research should be invaluable for this. There will be disputing among the experts as to what is certain and what is not; perhaps the heat and duration of dispute could be adapted for the measurement of uncertainty. In any case, once a set of suitable questions becomes agreed upon, these can be approached by the most systematic methods of applied science.

However, I have a stronger hunch that the greatest part of the important biomedical research waiting to be done is in the class of basic science. There is an abundance of interesting facts relating to all of our major diseases, and more items of information are coming in steadily from all quarters of biology. The new mass of knowledge is still formless, incomplete, lacking the essential threads of connection, displaying misleading signals at every turn, riddled with blind alleys. There are fascinating ideas all over the place, irresistible experiments beyond numbering, all sorts of new ways into the maze of problems. But every next move is unpredictable, every outcome uncertain. It is a puzzling time, but a very good time.

I am, as I've indicated, an unqualified optimist about the future of medicine provided that we can keep the science going, and going in the right directions. One mistake which we could make, if we are unlucky, is to cut back the financial support of research to such an extent that we begin to lose the critical mass of good minds required for the job. Somehow, I doubt that this is going to happen. I believe that the biological revolution of the past 20 years has launched us on one of the really great events in human history, and I do not see how this can be turned off or turned back even though the pace can be slowed by lack of adequate support. The events that lie ahead are, it seems to me, absolutely inevitable. You cannot accumulate information of such power and profundity about the life of cells and tissues without uncovering the mechanisms of disease at the same time, and this is what I believe is beginning to happen. We are going to learn our way around disease, sooner or later, and this is a new fact of life.

We can make a worse mistake, and delay things for a longer time, by planning the science in the wrong way. If you begin by making the assumption that we know more than we really do, and are ready for full-scale applied science across the board, you can turn off all progress. I hope this will not happen in cancer research where almost all of the really important and interesting problems are matters of high uncertainty awaiting surprise answers. To be sure, there are a few areas of cancer ready for centrally planned applied science—the chemotherapy and radiation treatment of Hodgkin's disease and lymphomas provide good examples of this—but the major part of cancer research is still at the frontier of the unknown and has to be regarded as basic science. The same thing can be said for the problem of chronic nephritis and renal failure, for heart disease, stroke, multiple sclerosis, rheumatoid arthritis, schizophrenia, and all the rest.

The huge difference between our situation today and that of 10 years ago, or even 5 years ago, is that these all seemed then to be impenetrable mysteries and today we can see paths leading to what we think might turn out to be the center in each of them. They are now approachable and are soluble. That is the great challenge that has occurred in these last few years. The mechanisms of disease are soluble problems and now it is a matter of time.

Erwin Chargaff *was born in Austria in 1905 and moved to the United States in 1928. He has made significant contributions to the field of biochemistry. Among them are the discovery of the base pairing regularities in DNA and the demonstration of the existence of different deoxyribonucleic acids in different biological species. Chargaff, who has received many honors, is currently a professor emeritus at Columbia University. He co-edited the three-volume work* The Nucleic Acids.

Stanley Cohen, *a molecular geneticist, is professor and chairman of the Department of Genetics at the Stanford University School of Medicine. In 1973, he and his colleagues reported the first successful gene transplantation experiments. Cohen was also a member of the National Academy of Sciences' committee that first called for a pause in certain types of recombinant DNA studies.*

The following two short articles reflect the depth of the disagreement in the scientific community surrounding recombinant DNA research. Chargaff finds such research dangerous, and laments that "our time is cursed with the necessity for feeble men, masquerading as experts, to make enormously far-reaching decisions." He asks, "Is there anything more far-reaching than the creation of new forms of life?" He questions the wisdom of counteracting irreversibly through certain types of recombinant DNA research "the evolutionary wisdom of millions of years, in order to satisfy the ambition and the curiosity of a few scientists." "My generation," he concludes, "or perhaps the one preceding mine, has been the first to engage, under the leadership of the exact sciences, in a destructive colonial warfare against nature. The future will curse us for it."

Cohen, on the other hand, is quite optimistic about the benefits to be reaped from recombinant DNA research. "Use of recombinant DNA techniques has provided knowledge about how genes are organized into chromosomes and how expression is controlled. With such knowledge we can begin to learn how defects in the structure of such genes alter their function." To Chargaff's warning about counteracting the evolutionary wisdom of nature, Cohen retorts that "it is this so-called evolutionary wisdom that gave us the gene combinations for bubonic plague, smallpox, yellow fever, typhoid, polio, diabetes, and cancer." He concludes that "we must then examine the 'benefit' side of the picture—against the vague fear of the unknown that has in my opinion been the focal point of this controversy."

On the dangers of genetic meddling

ERWIN CHARGAFF

A bizarre problem is posed by recent attempts to make so-called genetic engineering palatable to the public. Presumably because they were asked to establish "guidelines," the National Institutes of Health have permitted themselves to be dragged into a controversy with which they should not have had anything to do. Perhaps such a request should have been addressed to the Department of Justice. But I doubt that they would have wanted to become involved with second-degree molecular biology.

Although I do not think that a terrorist organization ever asked the Federal Bureau of Investigation to establish guidelines on the proper conduct of bombing experiments. I do not doubt what the answer would have been; namely, that they ought to refrain from doing anything unlawful. This also applies to the case under discussion: no smokescreen, neither P3 nor P4 containment facilities, can absolve an experimenter from having injured a fellow being. I set my hope in the cleaning women and the animal attendants employed in laboratories playing games with "recombinant DNA"; in the law profession, which ought to recognize a golden opportunity for biological malpractice suits; and in the juries that dislike all forms of doctors.

In pursuing my quixotic undertaking—fighting windmills with an M.D. degree—I shall start with the cardinal folly, namely, the choice of *Escherichia coli* as the host. Permit me to quote from a respected textbook of microbiology: "*E. coli* is referred to as the 'colon bacillus' because it is the predominant facultative species in the large bowel."[1] In fact, we harbor several hundred different varieties of this useful microorganism. It is responsible for few infections but probably for more scientific papers than any other living organism. If our time feels called upon to create new forms of living cells—forms that the world has presumably not seen since its onset—why choose a microbe

☐ From *Science*, 192, 4 June 1976, pp. 938-940.

[1] B. D. Davis, R. Dulbecco, H. N. Eisen, et al., *Microbiology* (New York: Harper & Row, Publishers, Inc., 1967), p. 769.

that has cohabited, more or less happily, with us for a very long time indeed? The answer is that we know so much more about *E. coli* than about anything else, including ourselves. But is this a valid answer? Take your time, study diligently, and you will eventually learn a great deal about organisms that cannot live in men or animals. There is no hurry, there is no hurry whatever.

Here I shall be interrupted by many colleagues who assure me that they cannot wait any longer, that they are in a tremendous hurry to help suffering humanity. 'Without doubting the purity of their motives, I must say that nobody has, to my knowledge, set out clearly how he plans to go about curing everything from alkaptonuria to Zenker's degeneration, let alone replacing or repairing our genes. But screams and empty promises fill the air. "Don't you want cheap insulin? Would you not like to have cereals get their nitrogen from the air? And how about green man photosynthesizing his nourishment: 10 minutes in the sun for breakfast, 30 minutes for lunch, and 1 hour for dinner?" Well, maybe Yes, maybe No.

If Dr. Frankenstein must go on producing his little biological monsters—and I deny the urgency and even the compulsion—why pick *E. coli* as the womb? This is a field where every experiment is a "shotgun experiment," not only those so designated; and who knows what is really being implanted into the DNA of the plasmids which the bacillus will continue multiplying to the end of time? And it will eventually get into human beings and animals despite all the precautions of containment. What is inside will be outside. Here I am given the assurance that the work will be done with enfeebled lambda and with modified, defective *E. coli* strains that cannot live in the intestine. But how about the exchange of genetic material in the gut? How can we be sure what would happen once the little beasts escaped from the laboratory? Let me quote once more from the respected textbook: "Indeed, the possibility cannot be dismissed that genetic recombination in the intestinal tract may even cause harmless enteric bacilli occasionally to become virulent."[2] I am thinking, however, of something much worse than virulence. We are playing with hotter fires.

It is not surprising, but it is regrettable that the groups that entrusted themselves with the formulation of "guidelines," as well as the several advisory committees, consisted exclusively, or almost exclusively, of advocates of this form of genetic experimentation. What seems to have been disregarded completely is that we are dealing here much more with an ethical problem than with one in public health, and that the principal question to be answered is whether we have the right to put an additional fearful load on generations that are not yet born. I use the adjective "additional" in view of the unresolved and equally fearful problem of the disposal of nuclear waste. Our time is cursed with the necessity for feeble men, masquerading as experts, to make enormously far-reaching decisions. Is there anything more far-reaching than the creation of new forms of life?

Recognizing that the National Institutes of Health are not equipped to deal with a dilemma of such import, I can only hope against hope for congressional action. One could, for instance, envision the following steps: (i) a complete prohibition of the use of bacterial hosts that are indigenous to man; (ii) the creation of an authority, truly representative of the population of this country, that would support and license research on less objectionable hosts and procedures; (iii) all forms of "genetic engineering" remaining a federal monopoly; (iv) all research eventually being carried out in one place, such as Fort Detrick. It is clear that a moratorium of some sort will have to precede the erection of legal safeguards.

But beyond all this, there arises a general problem of the greatest significance, namely, the awesome irreversibility of what is being contemplated. You can stop splitting the atom; you can stop visiting the moon; you can stop using aerosols; you may even decide not to kill entire populations by the use of a few bombs. But you cannot recall a new form of life. Once you have constructed a viable *E. coli* cell carrying a plasmid DNA into which a piece of eukaryotic DNA has been spliced, it will survive you and your children and your children's children. An irreversible attack on the biosphere is something so unheard-of, so unthinkable to previous generations, that I could only wish that mine had not been guilty of it. The hybridization of Prometheus with Herostratus is bound to give evil results.

Most of the experimental results published so far in this field are actually quite unconvincing. We understand very little about eukaryotic

2. Davis, Dulbecco, Eisen, et al., p. 769.

DNA.[3] The significance of spacer regions, repetitive sequences, and, for that matter, of heterochromatin[4] is not yet fully understood. It appears that the recombination experiments in which a piece of animal DNA is incorporated into the DNA of a microbial plasmid are being performed without a full appreciation of what is going on. Is the position of one gene with respect to its neighbors on the DNA chain accidental or do they control and regulate each other? Can we be sure—to mention one fantastic improbability—that the gene for a given protein hormone, operative only in certain specialized cells, does not become carcinogenic when introduced naked into the intestine? Are we wise in getting ready to mix up what nature has kept apart, namely the genomes of eukaryotic and prokaryotic cells?[5]

3. Eukaryotic DNA is the DNA of higher organisms which are composed of cells with nuclei—for example, animal DNA. [ed. note]
4. Heterochromatin is a kind of chromatin. Chromatin is the material of which chromosomes are made. [ed. note]
5. Prokaryotic cells are cells with no nuclei. All bacteria are prokaryotes. [ed. note]

The worst is that we shall never know. Bacteria and viruses have always formed a most effective biological underground. The guerilla warfare through which they act on higher forms of life is only imperfectly understood. By adding to this arsenal freakish forms of life—prokaryotes propagating eukaryotic genes—we shall be throwing a veil of uncertainties over the life of coming generations. Have we the right to counteract, irreversibly, the evolutionary wisdom of millions of years, in order to satisfy the ambition and the curiosity of a few scientists?

This world is given to us on loan. We come and we go; and after a time we leave earth and air and water to others who come after us. My generation, or perhaps the one preceding mine, has been the first to engage, under the leadership of the exact sciences, in a destructive colonial warfare against nature. The future will curse us for it.

Recombinant DNA: fact and fiction

STANLEY N. COHEN

Almost 3 years ago, I joined with a group of scientific colleagues in publicly calling attention to possible biohazards of certain kinds of experiments that could be carried out with newly developed techniques for the propagation of genes from diverse sources in bacteria *(1)*. Because of the newness and relative simplicity of these techniques *(2)*, we were concerned that experiments involving certain genetic combinations that seemed to us to be hazardous might be performed before adequate consideration had been given to the potential dangers. Contrary to what was believed by many observers, our concerns pertained to a few very specific types of experiments that could be carried out with the new techniques, not to the techniques themselves.

Guidelines have long been available to protect laboratory workers and the general public against known hazards associated with the handling of certain chemicals, radioisotopes, and pathogenic microorganisms; but because of the newness of recombinant DNA techniques, no guidelines were yet available for this research. My colleagues and I wanted to be sure that these new techniques would not be used, for example, for the construction of streptococci or pneumococci resistant to penicillin, or for the creation of *Escherichia coli* capable of synthesizing botulinum toxin or diphtheria toxin. We asked that these experiments not be done, and also called for deferral of construction of bac-

☐ From *Science*, 195, 18 February 1977, pp. 654-657.

terial recombinants containing tumor virus genes until the implications of such experiments could be given further consideration.

During the past 2 years, much fiction has been written about "recombinant DNA research." What began as an act of responsibility by scientists, including a number of those involved in the development of the new techniques, has become the breeding ground for a horde of publicists—most poorly informed, some well-meaning, some self-serving. In this article I attempt to inject some relevant facts into the extensive public discussion of recombinant DNA research.

SOME BASIC INFORMATION

Recombinant DNA research is not a single entity, but rather it is a group of techniques that can be used for a wide variety of experiments. Much confusion has resulted from a lack of understanding of this point by many who have written about the subject. Recombinant DNA techniques, like chemicals on a shelf, are neither good nor bad per se. Certain experiments that can be done with these techniques are likely to be hazardous (just as certain experiments done with combinations of chemicals taken from the shelf will be hazardous), and there is universal agreement that such recombinant DNA experiments should not be done. Other experiments in which the very same techniques are used—such as taking apart a DNA molecule and putting segments of it back together again—are without conceivable hazard, and anyone who has looked into the matter has concluded that these experiments can be done without concern.

Then, there is the area "in between." For many experiments, there is no evidence of biohazard, but there is also no certainty that there is not a hazard. For these experiments, guidelines have been developed in an attempt to match a level of containment with a degree of hypothetical risk. Perhaps the single point that has been most misunderstood in the controversy about recombinant DNA research, is that discussion of "risk" in the middle category of experiments relates entirely to hypothetical and speculative possibilities, not expected consequences or even phenomena that seem likely to occur on the basis of what is known. Unfortunately, much of the speculation has been interpreted as fact.

There is nothing novel about the principle of matching a level of containment with the level of anticipated hazard; the containment procedures used for pathogenic bacteria, toxic substances, and radioisotopes attempt to do this. However, the containment measures used in these areas address themselves only to known hazards and do not attempt to protect against the unknown. If the same principle of protecting only against known or expected hazards were followed in recombinant DNA research, there would be no containment whatsoever except for a very few experiments. In this instance, we are asking not only that there be no evidence of hazard, but that there be positive evidence that there is no hazard. In developing guidelines for recombinant DNA research, we have attempted to take precautionary steps to protect ourselves against hazards that are not known to exist—and this unprecedented act of caution is so novel that it has been widely misinterpreted as implying the imminence or at least the likelihood of danger.

Much has been made of the fact that even if a particular recombinant DNA molecule shows no evidence of being hazardous at the present time, we are unable to say for certain that it will not devastate our planet some years hence. Of course this view is correct; similarly, we are unable to say for certain that the vaccines we are administering to millions of children do not contain agents that will produce contagious cancer some years hence, we are unable to say for certain that a virulent virus will not be brought to the United States next winter by a traveler from abroad, causing a nationwide fatal epidemic of a hitherto unknown disease—and we are unable to say for certain that novel hybrid plants being bred around the world will not suddenly become weeds that will overcome our major food crops and cause worldwide famine.

The statement that potential hazards could result from certain experiments involving recombinant DNA techniques is akin to the statement that a vaccine injected today into millions of people *could* lead to infectious cancer in 30 years, a pandemic caused by a traveler-borne virus *could* devastate the United States, or a new plant species *could* uncontrollably destroy the world's food supply. We have no reason to expect that any of these things will happen, but we are unable to say for certain that they will not happen. Similarly, we are unable to guarantee that any of man's efforts to influence the earth's weather, explore space, modify crops, or cure disease will not carry with them the seeds for the ultimate destruction of civilization. Can we in fact point to one major area of human activity where one can say *for certain* that there is zero risk? Potentially, we could respond to such risks by taking measures such as prohibiting foreign travel to reduce the hazard of deadly virus importation and stopping experimentation with hybrid plants. It is possible to develop plausible "scare scenarios" involving virtually any activity or process, and these would have as much (or as little) basis in fact as most of the scenarios involving recombinant DNA. But we must distinguish fear of the unknown from fear that has some basis in fact; this appears to be the crux of the controversy surrounding recombinant DNA.

Unfortunately, the public has been led to believe that the biohazards described in various scenarios are likely or probably outcomes of recombinant DNA research. "If the scientists themselves are concerned enough to raise the issue," goes the fiction, "the problem is probably much worse than anyone will admit." However, the simple fact is that there is no evidence that a bacterium carrying any recombinant DNA molecule poses a hazard beyond the hazard that can be anticipated from the known properties of the components of the recombinant. And experiments involving genes that produce toxic substances or pose other known hazards are prohibited.

FREEDOM OF SCIENTIFIC INQUIRY

This issue has been raised repeatedly during discussions of recombinant DNA research. "The time has come," the critics charge, "for scientists to abandon their long-held belief that they should be free to pursue the acquisition of new knowledge regardless of the consequences." The fact is that no one has proposed that freedom of inquiry should extend to scientific experiments that endanger public safety. Yet, "freedom of scientific inquiry" is repeatedly raised as a straw-man issue by critics who imply that somewhere there are those who argue that there should be no restraint whatsoever on research.

Instead, the history of this issue is one of self-imposed restraint by scientists from the very start. The scientific group that first raised the question of possible hazard in some kinds of recombinant DNA experiments included most of the scientists involved in the development of the techniques—and their concern was made public so that other investigators who might not have adequately considered the possibility of hazard could exercise appropriate restraint. While most scientists would defend their right to freedom of scientific thought and discourse, I do not know of anyone who has proposed that scientists should be free to do whatever experiments they choose regardless of the consequences.

INTERFERENCE WITH "EVOLUTIONARY WISDOM"

Some critics of recombinant DNA research ask us to believe that the process of evolution of plants, animals, and microbes has remained delicately controlled for millions of years, and that the construction of recombinant DNA molecules now threatens the master plan of evolution. Such thinking, which requires a belief that nature is endowed with wisdom, intent, and foresight, is alien to most post-Darwinian biologists *(3)*. Moreover, there is no evidence that the evolutionary process is delicately controlled by nature. To the contrary, man has long ago modified the process of evolution, and biological evolution continues to be influenced by man. Primitive man's domestication of animals and cultivation of crops provided an "unnatural" advantage to certain biological species and a consequent perturbation of evolution. The later creation by man of hybrid plants and animals has resulted in the propagation of new genetic combinations that are not the products of natural evolution. In the microbiological world, the use of antimicrobial agents to treat bacterial infections and the advent of mass immunization programs against viral disease has made untenable the thesis of delicate evolutionary control.

A recent letter *(4)* that has been widely quoted by critics of recombinant DNA research asks, "Have we the right to counteract irreversibly the evolutionary wisdom of millions of years. . . ?" It is this so-called evolutionary wisdom that gave us the gene combinations for bubonic plague, smallpox, yellow fever, typhoid, polio, diabetes, and cancer. It is this wisdom that continues to give us uncontrollable diseases such as Lassa fever, Marburg virus, and very recently the Marburg-related hemorrhagic fever virus, which has resulted in nearly 100 percent mortality in infected individuals in Zaire and the Sudan. The acquisition and use of all biological and medical knowledge constitutes an intentional and continuing assault on evolutionary wisdom. Is this the "warfare against nature" that some critics fear from recombinant DNA?

HOW ABOUT THE BENEFITS?

For all but a very few experiments, the risks of recombinant DNA research are speculative. Are the benefits equally speculative or is there some factual basis for expecting that benefits will occur from this technique? I believe that the anticipation of benefits has a substantial basis in fact, and that the benefits fall into two principal categories: (i) advancement of fundamental scientific and medical knowledge, and (ii) possible practical applications.

In the short space of 3½ years, the use of the recombinant DNA technology has already been of major importance in the advancement of fundamental knowledge. We need to understand the structure and function of genes, and this methodology provides a way to isolate large quantities of specific segments of DNA in pure form. For example, recombinant DNA methodology has provided us with much information about the structure of plasmids that cause antibiotic resistance in bacteria, and has given us insights into how these elements propagate themselves, how they evolve, and how their genes are regulated. In the past, our inability to isolate specific genetic regions of the chromosomes of higher organisms has limited our understanding of the genes of complex cells. Now use of recombinant DNA techniques has provided knowledge about how genes are organized into chromosomes and how gene expression is controlled. With such knowledge we can begin to learn how defects in the structure of such genes alter their function.

On a more practical level, recombinant DNA techniques potentially permit the construction of bacterial strains that can produce biologically important substances such as antibodies and hormones. Although the full expression of higher organism DNA that is necessary to accomplish such production has not yet been achieved in bacteria, the steps that need to be taken to reach this goal are defined, and we can reasonably expect that the introduction of appropriate "start" and "stop" control signals into recombinant DNA molecules will enable the expression of animal cell genes. On an even shorter time scale, we can expect recombinant DNA techniques to revolutionize the production of antibiotics, vitamins, and medically and industrially useful chemicals by eliminating the need to grow and process the often exotic bacterial and fungal strains currently used as sources for such agents. We can anticipate the construction of modified antimicrobial agents that are not destroyed by the antibiotic inactivating enzymes responsible for drug resistance in bacteria.

In the area of vaccine production, we can anticipate the construction of specific bacterial strains able to produce desired antigenic products, eliminating the present need for immunization with killed or attenuated specimens of disease-causing viruses.

One practical application of recombinant DNA technology in the area of vaccine production is already close to being realized. An *E. coli* plasmid coding for an enteric toxin fatal to livestock has been taken apart, and the toxin gene has been separated from the remainder of the plasmid. The next step is to cut away a small segment of the toxin-producing gene so that the substance produced by the resulting gene in *E. coli* will not have toxic properties but will be immunologically active in stimulating antibody production.

Other benefits from recombinant DNA research in the areas of food and energy production are more speculative. However, even in these areas there is a scientific basis for expecting that the benefits will someday be realized. The limited availability of fertilizers and the potential hazards associated with excessive use of nitrogen fertilizers now limits the yields of grain and other crops, but agricultural experts suggest that transplantation of the nitrogenase system from the chromosomes of certain bacteria into plants or into other bacteria that live symbiotically with food crop plants may eliminate the need for fertilizers. For many years, scientists have modified the heredity of plants by comparatively primitive techniques. Now there is a means of doing this with greater precision than has been possible previously.

Certain algae are known to produce hydrogen from water, using sunlight as energy. This process potentially can yield a virtually limitless source of pollution-free energy if technical and biochemical problems indigenous to the known hydrogen-producing organisms can be solved. Recombinant DNA techniques offer a possible means of solution to these problems.

It is ironic that some of the most vocal opposition to recombinant DNA research has come from those most concerned about the environment. The ability to manipulate microbial genes offers the promise of more effective utilization of renewable resources for mankind's food and energy needs; the status quo offers the prospect of progressive and continuing devastation of the environment. Yet, some environmentalists have been misled into taking what I believe to be an antienvironmental position on the issue of recombinant DNA.

THE NIH GUIDELINES

Even if hazards are speculative and the potential benefits are significant and convincing, wouldn't it still be better to carry out recombinant DNA experiments under conditions that provide an added measure of safety—just in case some of the conjectural hazards prove to be real?

This is exactly what is required under the NIH (National Institutes of Health) guidelines *(5)* for recombinant DNA research:

1) These guidelines prohibit experiments in which there is some scientific basis for anticipating that a hazard will occur. In addition, they prohibit experiments in which a hazard, although it might be entirely speculative, was judged by NIH to be potentially serious enough to warrant prohibition of the experiment. The types of experiment that were the basis of the initial "moratorium" are included in this category; contrary to the statements of some who have written about recombinant DNA research, there has in fact been no lifting of the original restrictions on such experiments.

2) The NIH guidelines require that a large class of other experiments be carried out in P4 (high level) containment facilities of the type designed for work with the most hazardous naturally occurring microorganisms known to man (such as Lassa fever virus, Marburg virus, and Zaire hemorrhagic fever virus). It is difficult to imagine more hazardous self-propagating biological agents than such viruses, some of which lead to nearly 100 percent mortality in infected individuals. The P4 containment requires a specially built laboratory with airlocks and filters, biological safety cabinets, clothing changes for personnel, autoclaves within the facility, and the like. This level of containment is required for recombinant DNA experiments for which there is at present no evidence of hazard, but for which it is perceived that the hazard might be potentially serious if conjectural fears prove to be real. There are at present only four or five installations in the United States where P4 experiments could be carried out.

3) Experiments associated with a still lesser degree of hypothetical risk can be conducted in P3 containment facilities. These are also specially constructed laboratories requiring double door entrances, negative air pressure, and special air filtration devices. Facilities where P3 experiments can be performed are limited in number, but they exist at some universities.

4) Experiments in which the hazard is considered unlikely to be serious even if it occurs still require laboratory procedures (P2 containment) that have for years been considered sufficient for research with such pathogenic bacteria as *Salmonella typhosa, Clostridium botulinum,* and *Cholera vibrio*. The NIH guidelines require that P2 facilities be used for work with bacteria carrying interspecies recombinant DNA molecules that have shown no evidence of being hazardous—and even for some recombinant DNA experiments in which there is substantial evidence of lack of hazard.

5) The P1 (lowest) level of containment can be used only for recombinant DNA molecules that potentially can be made by ordinary biological gene exchange in bacteria. Conformity to even this lowest level of containment in the laboratory requires decontamination of work surfaces daily and after spills of biological materials, the use of mechanical pipetting devices or cotton plugged pipettes by workers, a pest control program, and decontamination of liquid and solid waste leaving the laboratory.

In other areas of actual or potential biological hazard, physical containment is all that microbiologists have had to rely upon; if the Lassa fever virus were to be released inadvertently from a P4 facility, there would be no further barrier to prevent the propagation of this virus which is known to be deadly and for which no specific therapy exists. However, the NIH guidelines for recombinant DNA research have provided for an additional level of safety for workers and the public: This is a system of biological containment that is designed to reduce by many orders of magnitude the chance of propagation outside the laboratory of microorganisms used as hosts for recombinant DNA molecules.

An inevitable consequence of these containment procedures is that they have made it difficult for the public to appreciate that most of the hazards under discussion are conjectural. Because in the past, governmental agencies have often been slow to respond to clear and definite dangers in other areas of technology, it has been inconceivable to scientists working in other fields and to the public at large that an extensive and costly federal machinery would have been established to provide protection in this area of research unless severe hazards were known to exist. The fact that recombinant DNA research has prompted international meetings, extensive coverage in the news media, and governmental intervention at the federal level has been perceived by the public as prima facie evidence that this research must be more dangerous than all the rest. The scientific community's response has been to establish increasingly elaborate procedures to police itself—but these very acts of scientific caution and responsibility have only served to perpetuate and strengthen the general belief that the hazards under discussion must be clear-cut and imminent in order for such steps to be necessary.

It is worth pointing out that despite predictions of imminent disaster from recombinant DNA experiments, the fact remains that during the past 3½ years, many billions of bacteria containing a wide variety of recombinant DNA molecules have been grown and propagated in the United States and abroad, incorporating DNA from viruses, protozoa, insects, sea urchins, frogs, yeast, mammals, and unrelated bacterial species into *E. coli,* without hazardous consequences so far as I am aware. And the majority of these experiments were carried out prior to the strict containment procedures specified in the current federal guidelines.

Despite the experience thus far, it will always be valid to argue that recombinant DNA molecules that seem safe today may prove hazardous tomorrow. One can no more prove the safety of a particular genetic combination under all imaginable circumstances than one can prove that currently administered vaccines do not contain an undetected self-propagating agent capable of producing cancer in the future, or that a hybrid plant created today will not lead to disastrous consequences some years hence. No matter what evidence is collected to document the safety of a new therapeutic agent, a vaccine, a process, or a particular kind of recombinant DNA molecule, one can always conjure up the possibility of future hazards that cannot be disproved. When one deals with conjecture, the number of possible hazards is unlimited; the experiments that can be done to establish the absence of hazard are finite in number.

Those who argue that we should not use recombinant DNA techniques until or unless we are absolutely certain that there is zero risk fail to recognize that no one will ever be able to guarantee total freedom from risk in any significant human activity. All that we can reasonably expect is a mechanism for dealing responsibly with hazards that are known to exist or which appear likely on the basis of information that is known. Beyond this, we can and should exercise caution in any activity that carries us into previously uncharted territory, whether it is recombinant DNA research, creation of a new drug or vaccine, or bringing a spaceship back to Earth from the moon.

Today, as in the past, there are those who would like to think that there is freedom from risk in the status quo. However, humanity continues to be buffeted by ancient and new diseases, and by malnutrition and pollution; recombinant DNA techniques offer a reasonable expectation for a partial solution to some of these problems. Thus, we must ask whether we can afford to allow preoccupation with and conjecture about hazards that are not known to exist, to limit our ability to deal with hazards that do exist. Is there in fact greater risk in proceeding judiciously, or in not proceeding at all? We must ask whether there is any rational basis for predicting the dire consequences of recombinant DNA research portrayed in the scenarios proposed by some. We must then examine the "benefit" side of the picture and weigh the already realized benefits and the reasonable expectation of additional benefits, against the vague fear of the unknown that has in my opinion been the focal point of this controversy.

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Sex control, science and society

AMITAI ETZIONI

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In the following selection from Genetic Fix, *another of his books, Etzioni is concerned about the freedom of scientific research in this age of technological innovations. He asks: "Are there any circumstances under which the societal well-being justifies some limitation on the freedom of research?" To make this issue more concrete, he focuses on the problem of sex control. Technology may in the future afford parents the choice of the sex of their offspring. The benefits of such an opportunity are obvious. The harmful effects are numerous. Given our societal values, parents would tend to favor having boys. The accumulative effect of the resulting sex imbalance in society would have social, ethical, and political ramifications of great significance. Society would not collapse, but, asks Etzioni, "Are the costs justified?"*

He does not think so. He concludes that "what may have to be considered now is a more preventive and more national effective guidance, one that would discourage the development of those technologies which, studies would suggest, are likely to cause significantly more damage than payoffs."

Using various techniques developed as a result of fertility research, scientists are experimenting with the possibility of sex control, the ability to determine whether a newborn infant will be a male or a female. So far, they have reported considerable success in their experiments with frogs and rabbits, whereas the success of experiments with human sperm appears to be quite limited, and the few optimistic reports seem to be unconfirmed. Before this new scientific potentiality becomes a reality, several important questions must be considered. What would be the societal consequences of sex control? If they are, on balance, undesirable, can sex control be prevented without curbing the freedoms essential for scientific work? The scientific ethics already impose some restraints on research to safeguard the welfare and privacy of the researched population. Sex control, however, might affect the whole society. Are there any circumstances under which the societal well-being justifies some limitation on the freedom of research? These questions apply, of course, to many other areas of scientific inquiry, such as work on the biological code and the experimental use of behavior and thought-modifying drugs. Sex control provides a useful opportunity for discussion of these issues because it presents a relatively "low-key" problem. Success seems fairly remote, and, as we shall see, the deleterious effects of widespread sex control would probably not be very great. Before dealing with the possible societal effects of sex control, and the ways they may be curbed, I describe the work that has already been done in this area.

☐ From *Science*, 161, 13 September 1968, pp. 1107-1112.

THE STATE OF THE ART

Differential centrifugation provided one major approach to sex control. It was supposed that since X and Y chromosomes differ in size (Y is considerably smaller), the sperm carrying the two different types would also be of two different weights; the Y-carrying sperm would be smaller and lighter, and the X-carrying sperm would be larger and heavier. Thus, the two kinds could be separated by centrifugation and then be used in artificial insemination. Early experiments, however, did not bear out this theory. And, Witschi pointed out that, in all likelihood, the force to be used in centrifugation would have to be of such magnitude that the sperm may well be damaged *(1)*.

In the 1950s a Swedish investigator, Lindahl *(2)*, published accounts of his results with the use of counterstreaming techniques of centrifugation. He found that by using the more readily sedimenting portion of bull spermatozoa that had undergone centrifugation, fertility was decreased but the number of male calves among the offspring was relatively high. His conclusion was that the female-determining spermatozoa are more sensitive than the male and are damaged due to mechanical stress in the centrifuging process.

Electrophoresis of spermatozoa is reported to have been successfully carried out by a Soviet biochemist, V. N. Schröder, in 1932 *(3)*. She placed the cells in a solution in which the *p*H could be controlled. As the *p*H of the solution changed, the sperm moved with different speeds and separated into three groups: some concentrated next to the anode, some next to the cathode, and some were bunched in the middle. In tests conducted by Schröder and N. K. Kolstov *(3)*, sperm which collected next to the anode produced six offspring, all females; those next to the cathode—four males and one female; and those which bunched in the center—two males and two females. Experiments with rabbits over the subsequent 10 years were reported as successful in controlling the sex of the offspring in 80 percent of the cases. Similar success with other mammals is reported.

At the Animal Reproduction Laboratory of Michigan State University, Gordon replicated these findings, although with a lower rate of success *(4)*. Of 167 births studied, in 31 litters, he predicted correctly the sex of 113 offspring, for an average of 67.7 percent. Success was higher for females (62 out of 87, or 71.3 percent) than for males (51 out of 80, or 63.7 percent).

From 1932 to 1942, emphasis in sex control was on the acid-alkali method. In Germany, Unterberger reported in 1932 that in treating women with highly acidic vaginal secretions for sterility by use of alkaline douches, he had observed a high correlation between alkalinity and male offspring. Specifically, over a 10-year period, 53 out of 54 treated females are reported to have had babies, and all of the babies were male. In the one exception, the woman did not follow the doctor's prescription, Unterberger reported *(5)*. In 1942, after repeated tests and experiments had not borne out the earlier results, interest in the acid-alkali method faded *(6)*.

It is difficult to determine the length of time it will take to establish routine control of the sex of animals (of great interest, for instance, to cattle breeders); it is even more difficult to make such an estimate with regard to the sex control of human beings. In interviewing scientists who work on this matter, we heard conflicting reports about how close such a breakthrough was. It appeared that both optimistic and pessimistic estimates were vague—"between 7 to 15 years"—and were not based on any hard evidence but were the researchers' way of saying, "don't know" and "probably not very soon." No specific roadblocks which seemed unusually difficult were cited, nor did they indicate that we have to await other developments before current obstacles can be removed. Fertility is a study area in which large funds are invested these days, and we know there is a correlation between increased investment and findings *(7)*. Although most of the money is allocated to birth control rather than sex-control studies, information needed for sex-control research has been in the past a by-product of the originally sponsored work. Schröder's findings, for example, were an accidental result of a fertility study she was conducting *(4*, p. 90). Nothing we heard from scientists working in this area would lead one to conclude that there is any specific reason we could not have sex control 5 years from now or sooner.

In addition to our uncertainty about when sex control might be possible, the question of how it would be effected is significant and also one on which there are differences of opinion. The mechanism for practicing sex control is important because certain techniques have greater psychic costs than others. We can see today, for example, that some methods of contraception are preferred by some classes of people because they involve less psychic "discomfort" for them; for example, the intrauterine device is preferred over sterilization by most women. In the same way, although electrophoresis now seems to offer a promising approach to sex control, its use would entail artificial insemination. And whereas the objections to artificial insemination are probably decreasing, the resistance to it is still considerable *(8)*. (Possibly, the opposition to artificial insemination would not be as great in a sex-control situation because the husband's own sperm could be used.) If drugs taken orally or douches could be relied upon, sex control would probably be much less expensive (artificial insemination requires a doctor's help), much less objectionable emotionally, and significantly more widely used.

In any event both professional forecasters of the future and leading scientists see sex control as a mass practice in the foreseeable future. Kahn and Wiener, in their discussion of the year 2000, suggest that one of the "one hundred technical innovations likely in the next thirty-three years" is the "capability to choose the sex of unborn children'' *(9)*. Muller takes a similar position about gene control in general *(10)*.

SOCIETAL USE OF SEX CONTROL

If a simple and safe method of sex control were available, there would probably be no difficulty in finding the investors to promote it because there is a mass-market potential. The demand for the new freedom to choose seems well established. Couples have preferences on whether they want boys or girls. In many cultures boys provide an economic advantage (as workhorses) or as a form of old-age insurance (where the state has not established it). Girls in many cultures are a liability; a dowry which may be a sizeable economic burden must be provided to marry them off. (A working-class American who has to provide for the weddings of three or four daughters may appreciate the problem.) In other cultures, girls are profitably sold. In our own culture, prestige differences are attached to the sex of one's children, which seem to vary among ethnic groups and classes *(11*, pp. 6-7).

Our expectations as to what use sex control might be put in our society are not a matter of idle speculation. Findings on sex preferences are based on both direct ''soft'' and indirect ''hard'' evidence. For soft evidence, we have data on preferences parents expressed in terms of the number of boys and girls to be conceived in a hypothetical situation in which parents would have a choice in the matter. Winston studied 55 upperclassmen, recording anonymously their desire for marriage and children. Fifty-two expected to be married some day; all but one of these desired children; expectations of two or three children were common. In total, 86 boys were desired as compared to 52 girls, which amounts to a 65 percent greater demand for males than for females *(12)*.

A second study of attitudes, this one conducted on an Indianapolis sample in 1941, found similar preferences for boys. Here, while about half of the parents had no preferences (52.8 percent of the wives and 42.3 percent of the husbands), and whereas the wives with a preference tended to favor having about as many boys as girls (21.8 percent to 25.4 percent), many more husbands wished for boys (47.7 percent as compared to 9.9 percent) *(13)*.

Such expressions of preference are not necessarily good indicators of actual behavior. Hence of particular interest is ''hard'' evidence of what parents actually did—in the limited area of choice they already have: the sex composition of the family at the point they decided to stop having children. Many other and more powerful factors affect a couple's decision to curb further births, and the sex composition of their children is one of them. That is, if a couple has three girls and it strongly desires a boy, this is one reason it will try ''once more.'' By comparing the number of families which had only or mainly girls and ''tried once more'' to those which had only or mainly boys, we gain some data as to which is considered a less desirable condition. A somewhat different line was followed in an early study. Winston studied 5466 completed families and found that there were 8329 males born alive as compared to 7434 females, which gives a sex ratio at birth of 112.0. The sex ratio of the last child, which is of course much more indicative, was 117.4 (2952 males to 2514 females). That is, significantly more families stopped having children after they had a boy than after they had a girl.

The actual preference for boys, once sex control is available, is likely to be larger than these studies suggest for the following reasons. Attitudes, especially where there is no actual choice, reflect what people believe they ought to believe in, which, in our culture, is equality of the sexes. To prefer to produce boys is lower class and discriminatory. Many middle-class parents might entertain such preferences but be either unaware of them or unwilling to express them to an interviewer, especially since at present there is no possibility of determining whether a child will be a boy or a girl.

Also, in the situations studied so far, attempts to change the sex composition of a family involved having more children than the couple wanted, and the chances of achieving the desired composition were 50 percent or lower. Thus, for instance, if parents wanted, let us say, three children including at least one boy, and they had tried three times and were blessed with girls, they would now desire a boy strongly enough to overcome whatever resistance they had to have additional children before they would try again. This is much less practical than taking a medication which is, let us say, 99.8 percent effective and having the number of children you actually want and are able to support. That is, sex control by a medication is to be expected to be significantly more widely practiced than conceiving more children and gambling on what their sex will be.

Finally, and most importantly, such decisions are not made in the abstract, but affected by the social milieu. For instance, in small *kibbutzim* many more children used to be born in October and November each year than any other months because the community used to consider it undesirable for the children to enter classes in the middle of the school year, which in Israel begins after the high holidays, in October. Similarly, sex control—even if it were taboo or unpopular at first—could become quite widely practiced once it became fashionable.

In the following discussion we bend over backward by assuming that actual behavior would reveal a smaller preference than the existing data and preceding analysis would lead one to expect. We shall assume only a 7 percent difference between the number of boys and girls to be born alive due to sex control, coming on top of the 51.25 to 48.75 existing biological pattern, thus making for 54.75 boys to 45.25 girls, or a surplus of 9.5 boys out of every hundred. This would amount to a surplus of 357,234 in the United States, if sex control were practiced in a 1965-like population *(14)*.

The extent to which such a sex imbalance will cause social dislocations is in part a matter of the degree to which the effect will be cumulative. It is one thing to have an unbalanced baby crop one year, and quite another to produce such a crop several years in a row. Accumulation would reduce the extent to which girl shortages can be overcome by one age group raiding older and younger ones.

Some demographers seem to believe in an invisible hand (as it once was popular to expect in economics), and suggest that overproduction of boys will increase the value of girls and hence increase their production, until a balance is attained under controlled conditions which will be similar to the natural one. We need not repeat here the reasons such invisible arrangements frequently do not work; the fact is they simply cannot be relied upon, as recurrent economics crisis in pre-Keynesian days or overpopulation show.

Second, one ought to note the deep-seated roots of the boy-favoring factors. Although there is no complete agreement on what these factors are, and there is little research, we do know that they are difficult and slow to change. For instance, Winston argued that mothers prefer boys as a substitute for their own fathers, out of search for security or Freudian considerations. Fathers prefer boys because boys can more readily achieve success in our society (and in most others). Neither of these factors is likely to change rapidly if the percentage of boys born increases a few percentage points. We do not need to turn to alarmist conclusions, but we ought to consider what the societal effects of sex control might be under conditions of relatively small imbalance which, as we see it, will cause a significant (although not necessarily very high) male surplus, and a surplus which will be cumulative.

SOCIETAL CONSEQUENCES

In exploring what the societal consequences may be, we again need not rely on the speculation of what such a society would be like; we have much experience and some data on societies whose sex ratio was thrown off balance by war or immigration. For example, in 1960 New York City had 343,470 more females than males, a surplus of 68,366 in the 20- to 34-age category alone *(15)*.

We note, first, that most forms of social behavior are sex correlated, and hence that changes in sex composition are very likely to affect most aspects of social life. For instance, women read more books, see more plays, and in general consume more culture than men in the contemporary United States. Also, women attend church more often and are typically charged with the moral education of children. Males, by contrast, account for a much higher proportion of crime than females. A significant and cumulative male surplus will thus produce a society with some of the rougher features of a frontier town. And, it should be noted, the diminution of the number of agents of moral education and the increase in the number of criminals would accentuate already existing tendencies which point in these directions, thus magnifying social problems which are already overburdening our society.

Interracial and interclass tensions are likely to be intensified because some groups, lower classes and minorities specifically *(16)*, seem to be more male-oriented than the rest of the society. Hence while the sex imbalance in a society-wide average may be only a few percentage points, that of some groups is likely to be much higher. This may produce an especially high boy surplus in lower status groups. These extra boys would seek girls in higher status groups (or in some other religious group than their own) *(11)*—in which they also will be scarce.

On the lighter side, men vote systematically and significantly more Democratic than women; as the Republican party has been losing consistently in the number of supporters over the last generation anyhow, another 5-point loss could undermine the two-party system to a point where Democratic control would be uninterrupted. (It is already the norm, with Republicans having occupied the White House for 8 years over the last 36.) Other forms of imbalance which cannot be predicted are to be expected. ''All social life is affected by the proportions of the sexes. Wherever there exists a considerable predominance of one sex over the other, in point of numbers, there is less prospect of a well-ordered social life. . . . Unbalanced numbers inexorably produce unbalanced behavior *(17)*.''

Society would be very unlikely to collapse even if the sex ratio were to be much more seriously imbalanced than we expect. Societies are surprisingly flexible and adaptive entities. When asked what would be expected to happen if sex control were available on a mass basis, Davis, the well-known demographer, stated that some delay in the age of marriage of the male, some rise in prostitution and in homosexuality, and some increase in the number of males who will never marry are likely to result. Thus, all of the ''costs'' that would be generated by sex control will probably not be charged against one societal sector, that is, would not entail only, let us say, a sharp rise in prostitution, but would be distributed among several sectors and would therefore be more readily absorbed. An informal examination of the situation in the USSR and Germany after World War II (sex ratio was 77.7 in the latter) as well as Israel in early immigration periods, support Davis's nonalarmist position. We must ask, though, are the costs justified? The dangers are not apocalyptical; but are they worth the gains to be made?

A BALANCE OF VALUES

We deliberately chose a low-key example of the effects of science on society. One can provide much more dramatic ones; for example, the invention of new ''psychedelic'' drugs whose damage to genes will become known only much later (LSD was reported to have such effects), drugs which cripple the fetus (which has already occurred with the marketing of thalidomide), and the attempts to control birth with devices which may produce cancer (early versions of the intrauterine device were held to have such an effect). But let us stay with a finding which generates only relatively small amounts of human misery, relatively well distributed among various sectors, so as not to severely undermine society but only add, maybe only marginally, to the considerable social problems we already face. Let us assume that we only add to the unhappiness of seven out of every 100 born (what we consider minimum imbalance to be generated), who will not find mates and will have to avail themselves of prostitution, homosexuality, or be condemned to enforced bachelorhood. (If you know someone who is desperate to be married but cannot find a mate, this discussion will be less abstract for you; now multiply this by 357,234 per annum.) Actually, to be fair, one must subtract from the unhappiness that sex control almost surely will produce, the joy it will bring to parents who will be able to order the sex of their children; but as of now, this is for most, not an intensely felt need, and it seems a much smaller joy compared to the sorrows of the unmatable mates.

We already recognize some rights of human guinea pigs. Their safety and privacy are not to be violated even if this means delaying the progress of science. The ''rest'' of the society, those who are not the subjects of research, and who are nowadays as much affected as those in the laboratory, have been accorded fewer rights. Theoretically, new knowledge, the basis of new devices and drugs, is not supposed to leave the inner circles of science before its safety has been tested on animals or volunteers, and in some instances approved by a government agency, mainly the Federal Drug Administration. But as the case of lysergic acid diethylamide (LSD) shows, the trip from the reporting of a finding in a scientific journal to the bloodstream of thousands of citizens may be an extremely short one. The transition did take quite a number of years, from the days in 1943 when Hoffman, one of the two men who synthesized LSD-25 at Sandoz Research Laboratories, first felt its hallucinogenic effect, until the early 1960s, when it ''spilled'' into illicit campus use. (The trip from legitimate research, its use at Harvard, to illicit unsupervised use was much shorter.) The point is that no additional technologies had to be developed; the distance from the chemical formula to illicit composition required in effect no additional steps.

More generally, Western civilization, ever since the invention of the steam engine, has proceeded on the assumption that society must adjust to new technologies. This is a central meaning of what we refer to when we speak about an industrial revolution; we think about a society being transformed and not just a new technology being introduced into a society which continues to sustain its prior values and institutions. Although the results are not an unmixed blessing (for instance, pollution and traffic casualties), on balance the benefits in terms of gains in standards of living and life expectancy much outweigh the costs. (Whether the same gains could be made with fewer costs if society would more effectively guide its transformation and technology inputs, is a question less often discussed [*18*].) Nevertheless we must ask, especially with the advent of nuclear arms, if we can expect such a favorable balance in the future. We are aware that single innovations may literally blow up societies or civilization; we must also realize that the rate of social changes required by the accelerating stream of technological innovations, each less dramatic by itself, may supersede the rate at which society can absorb. Could we not regulate to some extent the pace and impact of the technological inputs and select among them without, by every such act, killing the goose that lays the golden eggs?

Scientists often retort with two arguments. Science is in the business of searching for truths, not that of manufacturing technologies. The applications of scientific findings are not determined by the scientists, but by society, politicians, corporations, and the citizens. Two scientists discovered the formula which led to the composition of LSD, but chemists do not determine whether it is used to accelerate psychotherapy or to create psychoses, or, indeed, whether it is used at all, or whether, like thousands of other studies and formulas, it is ignored. Scientists split the atom, but they did not decide whether particles would be used to produce energy to water deserts or superbombs.

Second, the course of science is unpredictable, and any new lead, if followed, may produce unexpected bounties: to curb some lines of inquiry—because they may have dangerous outcomes—may well force us to forego some major payoffs; for example, if one were to forbid the study of sex control one might retard the study of birth control. Moreover, leads which seem "safe" may have dangerous outcomes. Hence, ultimately, only if science were stopped altogether, might findings which are potentially dangerous be avoided.

These arguments are often presented as if they themselves were empirically verified or logically true statements. Actually they are a formula which enables the scientific community to protect itself from external intervention and control. An empirical study of the matter may well show that science does thrive in societies where scientists are given less freedom than the preceding model implies science must have—for example, in the Soviet Union. Even in the West in science some limitations on work are recognized and the freedom to study is not always seen as the ultimate value. Whereas some scientists are irritated when the health or privacy of their subject curbs the progress of their work, most scientists seem to recognize the priority of these other considerations. (Normative considerations also much affect the areas studied; compare, for instance, the high concern with a cancer cure to the almost complete unwillingness of sociologists, since 1954, to retest the finding that separate but equal education is not feasible.)

One may suggest that the society at large deserves the same protection as human subjects do from research. That is, the scientific community cannot be excused from the responsibility of asking what effects its endeavors have on the community. On the contrary, only an extension of the existing codes and mechanisms of self-control will ultimately protect science from a societal backlash and the heavy hands of external regulation. The intensification of the debate over the scientists' responsibilities with regard to the impacts of their findings is by itself one way of exercising it, because it alerts more scientists to the fact that the areas they choose to study, the ways they communicate their findings (to each other and to the community), the alliances they form or avoid with corporate and governmental interests—all these affect the use to which their work is put. It is simply not true that a scientist working on cancer research and one working on biological warfare are equally likely to come up with a new weapon and a new vaccine. Leads are not that random, and applications are not that readily transferable from one area of application to another.

Additional research on the societal impact of various kinds of research may help to clarify the issues. Such research even has some regulatory impact. For instance, frequently when a drug is shown to have been released prematurely, standards governing release of experimental drugs to mass production are tightened *(19)*, which in effect means fewer, more carefully supervised technological inputs into society; at least society does not have to cope with dubious findings. Additional progress may be achieved by studying empirically the effects that various mechanisms of self-regulation actually have on the work of scientists. For example, urging the scientific community to limit its study of some topics and focus on others may not retard science; for instance, sociology is unlikely to suffer from being now much more reluctant to concern itself with how the U.S. Army may stabilize or undermine foreign governments than it was before the blowup of Project Camelot *(20)*.

In this context, it may be noted that the systematic attempt to bridge the "two cultures" and to popularize science has undesirable side effects which aggravate the problem at hand. Mathematical formulas, Greek or Latin terminology, and jargon were major filters which allowed scientists in the past to discuss findings with each other without the nonprofessionals listening in. Now, often even preliminary findings are reported in the mass media and lead to policy adaptations, mass use, even legislation *(21)*, long before scientists have had a chance to double-check the findings themselves and their implications. True, even in the days when science was much more esoteric, one could find someone who could translate its findings into lay language and abuse it; but the process is much accelerated by well-meaning men (and foundations) who feel that although science ought to be isolated from society, society should keep up with science as much as possible. Perhaps the public relations efforts on behalf of science ought to be reviewed and regulated so that science may remain free.

A system of regulation which builds on the difference between science and technology, with some kind of limitations on the technocrats serving to protect societies, coupled with little curbing of scientists themselves, may turn out to be much more crucial. The societal application of most new scientific findings and principles advances through a sequence of steps, sometimes referred to as the R & D process. An abstract finding or insight frequently must be translated into a technique, procedure, or hardware, which in turn must be developed, tested, and mass-produced, before it affects society. While in some instances, like that of LSD, the process is extremely short in that it requires few if any steps in terms of further development of the idea, tools, and procedures, in most instances the process is long and expensive. It took, for instance, about $2 billion and several thousand applied scientists and technicians to make the first atomic weapons after the basic principles of atomic fission were discovered. Moreover, technologies often have a life of their own; for example, the intrauterine device did not spring out of any application of a new finding in fertility research but grew out of the evolution of earlier technologies.

The significance of the distinction between the basic research ("real" science) and later stages of research is that, first, the damage caused (if any) seems usually to be caused by the technologies and not by the science applied in their development. Hence if there were ways to curb damaging technologies, scientific research could maintain its almost absolute, follow-any-lead autonomy and society would be protected.

Second, and most important, the norms to which applied researchers and technicians subscribe and the supervisory practices, which already prevail, are very different than those which guide basic research. Applied research and technological work are already intensively guided by societal, even political, preferences. Thus, while about $2 billion a year of R & D money are spent on basic research more or less in ways the scientists see fit, the other $13 billion or so are spent on projects specifically ordered, often in great detail, by government authorities, for example, the development of a later version of a missile or a "spiced-up" tear gas. Studies of R & D corporations—in which much of this work is carried out, using thousands of professionals organized in supervised teams which are given specific assignments—pointed out that wide freedom of research simply does not exist here. A team assigned to cover a nose cone with many different alloys and to test which is the most heat-resistant is currently unlikely to stumble upon, let us say, a new heart pump, and if it were to come upon almost any other lead, the boss would refuse to allow the team to pursue the lead, using the corporation's time and funds specifically contracted for other purposes.

Not only are applied research and technological developments guided by economic and political considerations but also there is no evidence that they suffer from such guidance. Of course, one can overdirect any human activity, even the carrying of logs, and thus undermine morale, satisfaction of the workers, and their productivity; but such tight direction is usually not exercised in R & D work nor is it required for our purposes. So far guidance has been largely to direct efforts toward specific goals, and it has been largely corporate, in the sense that the goals have been chiefly set by the industry (for example, building flatter TV sets) or mission-oriented government agencies (for instance, hit the moon before the Russians). Some "preventive" control, like the suppression of run-proof nylon stockings, is believed to have taken place and to have been quite effective.

I am not suggesting that the direction given to technology by society has been a wise one. Frankly, I would like to see much less concern with military hardware and outer space and much more investment in domestic matters; less in developing new consumer gadgets and more in advancing the technologies of the public sector (education, welfare, and health); less concern with nature and more with society. The point though is that, for good or bad, technology is largely already socially guided, and hence the argument that its undesirable effects cannot be curbed because it cannot take guidance and survive is a false one.

What may have to be considered now is a more preventive and more national effective guidance, one that would discourage the development of those technologies which, studies would suggest, are likely to cause significantly more damage than payoffs. Special bodies, preferably to be set up and controlled by the scientific community itself, could be charged with such regulation, although their decrees might have to be as enforceable as those of the Federal Drug Administration. (The Federal Drug Administration, which itself is overworked and understaffed, deals mainly with medical and not societal effects of new technologies.) Such bodies could rule, for instance, that whereas fertility research ought to go on uncurbed, sex-control procedures for human beings are not to be developed.

One cannot be sure that such bodies would come up with the right decisions. But they would have several features which make it likely that they would come up with better decisions than the present system for the following reasons: (i) they would be responsible for protecting society, a responsibility which so far is not institutionalized; (ii) if they act irresponsibly, the staff might be replaced, let us say by a vote of the appropriate scientific associations; and (iii) they would draw on data as to the societal effects of new (or anticipated) technologies, in part to be generated at their initiative, while at present—to the extent such supervisory decisions are made at all—they are frequently based on folk knowledge.

Most of us recoil at any such notion of regulating science, if only at the implementation (or technological) end of it, which actually is not science at all. We are inclined to see in such control an opening wedge which may lead to deeper and deeper penetration of society into the scientific activity. Actually, one may hold the opposite view—that unless societal costs are diminished by some acts of self-regulation at the stage in the R & D process where it hurts least, the society may "backlash" and with a much heavier hand slap on much more encompassing and throttling controls.

The efficacy of increased education of scientists to their responsibilities, of strengthening the barriers between intrascientific communications and the community at large, and of self-imposed, late-phase controls may not suffice. Full solution requires considerable international cooperation, at least among the top technology-producing countries. The various lines of approach to protecting society discussed here may be unacceptable to the reader. The problem though must be faced, and it requires greater attention as we are affected by an accelerating technological output with ever-increasing societal ramifications, which jointly may overload society's capacity to adapt and individually cause more unhappiness than any group of men has a right to inflict on others, however noble their intentions.

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Technology, business, and political economy

The future world disorder: the structural context of crises

DANIEL BELL

In the following article Daniel Bell (who was introduced in Part Two) focuses on two "extraordinary sociological and geopolitical transformations in the social structures of the world" which occurred between 1948 and 1973. The first transformation took place, according to Bell, in Western advanced industrial nations, where there was a transition to a more open and egalitarian society. Two aspects of this transformation are the growth of union power and the spread of the Women's Liberation Movement. The second transformation occurred when the old international order collapsed and a large number of new states emerged. With their emergence new dichotomies in world politics superseded the old East-West dichotomy, and created new challenges for international stability. Underlying both these transformations were two "extraordinary technological revolutions: the revolution in transportation and communication . . . and the rise of the new science-based industries." The first tied the world closer together, while the second brought about "the postindustrial society."

Bell discusses four structural problems that the advanced industrial societies will face in the next decade as a result of the two transformations mentioned earlier. He draws a bleak picture of the situation, concluding that "the existing political structures no longer match the underlying economic and social realities," and that this mismatch may be the source of disintegration.

I

Historians now understand that Metternich—the other one, that is—made a strategic mistake at the Congress of Vienna. His policy was based on the premise that France, which had overrun almost all of Europe with Napoleon's armies, should not have the power to do so again. What he did not see was that in his backyard there would be looming a new and more powerful threat—that of an industrializing Germany.

The lack of foresight was understandable. Germany—to the extent that there was such an entity—had been disunited for almost a thousand years and the existing loose federation showed little promise of uniting. Indeed, if only for reasons of river-valley geography, the centralization of Germany, in any effective form, was not possible before the invention of the railroad.[1]

The cautionary moral of this tale is that today's policy-makers, in their understandable preoccupation with Great Power strategies, the rivalries of ideologies and national passions, the problems of nuclear proliferation and the like—all of which are their more immediate concerns—risk losing sight of changes in underlying contexts. These contexts are today necessarily more sociological than technological, more diffuse and difficult to define. And the issues to which they give rise are on a very different time scale from the crisis situations which flare up in the Middle East or in southern Africa, for example. But they nonetheless

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shape the problems that decision-makers will have to deal with in the next decade. Any attempts to deal with these issues require the redesign of political and social institutions and so confront both the inadequacies of economic and social knowledge and the resistance of traditions (which have their own justifications) and vested interests and privileged groups (which have great power).

What follows is thus not a forecast of the next decade—it could not be, for it eschews the overt political rivalries of the different powers, as well as such explosive questions as nuclear proliferation—but an effort to sketch the broad socio-economic context which, at its loosest, will constrain policy-makers and pose, in direct form, as yet unresolved dilemmas.

II

From 1948 to 1973, there was a 25-year boom in the world economy which was greater than that of any previous period in economic history. Gross Domestic Product, in real terms, increased by more than three and a half times, a world rate of over 5 per cent a year. Japan's growth was almost double that rate; Britain's was half.[2] This real per capita growth was shared almost equally by about half the world (the middle-income countries—e.g., Brazil and Mexico—being slightly the largest gainers). The very poor countries grew at an annual rate of 1.8 per cent, small in comparison with the others, respectable on the basis of their own past.[3]

The same period saw two extraordinary sociological and geopolitical transformations in the social structures of the world. Within the Western advanced industrial societies, there was the transition to a more open and egalitarian society: the inclusion of disadvantaged groups into the society, the expansion of educational opportunities, the growth of union power, the spread of Social Democratic governments,[4] the enlargment of personal liberties and the tolerance of diverse lifestyles, the spread of Women's Liberation, the increase in public spending on social services—in short, that complex of new social rights which is summed up in the ideas of the Welfare State, what I have called the "revolution of rising entitlements," and the greater freedom in culture and morals. With it came the cultural shocks to the older middle classes and the challenges to authority that arose first in the universities, with the student uprisings, and have spread to many other institutions in the society.

The second transformation, which in historical perspective is of greater import for the future, was the end of the old international order with a rapidity that had been almost entirely unforeseen,[5] and the emergence of a bewilderingly large number of new states of vastly diverse size, heterogeneity, and unevenly distributed resources. As a result of this development, the problem of international stability in the next 20 years will be the most difficult challenge for those responsible for the world polity. Some of the consequences of this transformation have been conceptualized as new North-South divisions, cutting across the East-West divisions which have been the axis of Great Power conflicts for almost all of modern times. Whether this is a useful conceptualization, or as vague and tendentious as the phrase "the Third World," is moot. (As Jean-Francois Revel has wryly observed: most of the South is East, but not all the North is West.) The fact remains that, just as within the advanced industrial societies of the West, so in the world at large, there has been a vast multiplication of new actors, new constituencies, new claimants in the political arenas of the world.

Underlying both these changes (though not determining them) have been two extraordinary technological revolutions: the revolution in transportation and communication which has tied the world together in almost real time[6] and the rise of the new science-based industries of what I have called the postindustrial society. The revolutions have given the Western countries an extraordinary advantage in high technology, and paved the way (if one can handle the huge problems of economic dislocation and displacement) for the transfer of a large part of the routinized manufacturing activities of the world to the less-developed countries.[7]

III

These structural changes, which have been taking place within each advanced industrial society and in the world economy, have created a new kind of "class struggle," with a greater potential for social instability and difficulties of governance than those characteristic of the old industrial order. The expansion everywhere of state-managed or state-directed societies—the most crucial political fact about the third quarter of the twentieth century—has meant the emergence of what Schumpeter years ago ironically called "fiscal sociology."

In this situation, the salient social struggles in the advanced—and, one must also say, open and democratic—industrial societies are less between employer and worker, as in the nineteenth and early twentieth centuries, than between organized social groups—syndicalist (such as trade unions), professional (such as academic, medical, scientific research complexes), corporate (business and even nonprofit economic enterprises), and intergovernmental units (states, cities, and counties)—for the allocation of the state budget.[8] And as state tax policy and direct state disbursements become central to the economic well-being of these groups, and as political decision-making rather than the market becomes decisive for a whole slew of economic questions (energy policy, land use, communications policy, product regulation and the like), the control and direction of the political system, not market power, becomes the central question for the society.

The corollary fact, that economic dealings between nations become more subject to national political controls, means that the international political arena becomes the cockpit for overt economic demands by the "external proletariat" (to use Toynbee's phrase) of the world against the richer industrial nations. Lin Piao may have perished in the plane crash in outer Mongolia, and China may, in the coming decades, be preoccupied with the building of "socialism in one country," but the call that Lin uttered a decade ago for the periphery of the world system to crush the core is a seismic force that could yet be released.

It is in this context that the worldwide recession which began in 1973 acquires such brutal significance. If the economic growth which has been the means of raising a large portion of the world into the middle class—and also a political solvent to meet the rising expectations of people and finance social welfare expenditures—cannot continue, then the tensions which are being generated will wrack every advanced industrial society and polarize the confrontation between the "south" (in all probability tied more and more to the "east") and the advanced industrialized, capitalist societies of the West.

The current recession can be interpreted in many ways. From a Marxist point of view, it is one more long swing in the inevitable fluctuations of the business cycle. For an economic historian like W.W. Rostow, we may be entering a new downward turn in the Kondratieff cycle, indicating an exhaustion of technological and investment possibilities. The difficulty with these statements is that they are so general and even contradictory. They do not take into account the structural changes in the character of contemporary capitalism, in particular the key role of the state. They are not responsive to what is the unique and different fact about the 1970s' recession, namely that it arose out of a worldwide inflation and that, as much as anything, it has been the deflationary actions of governments that have been responsible for the drop in industrial production and the rise of unemployment.

If one assembles the evidence about the 1970s' recession, one can see the conjoining of a number of short-term cyclical and longterm factors, with two wholly new elements—the surprise ability of the Organization of Petroleum Exporting Countries (OPEC) to create an effective cartel and to quadruple oil prices, and, ultimately more important, the worldwide synchronization of demand, indicating the emergence of a genuine world economy, which led to the inflationary pressures that brought about the end of the boom.

In one sense, the OPEC oil price rises imply a large-scale international redistribution of income which may continue for many years. This is a factor which every dependent economy has to take into account in estimating its costs and rate of possible growth. It is structural in a narrow political sense. But the synchronization of world-wide demand is a new structural feature of the world economy.

In a crucial sense, the modern era is defined as the shift in the character of economies—and in the nature of modern economic thinking—from supply to demand. For thousands of years, the level of supply (and its low technological foundation) dictated the standard of living. What has been singular about modern life is the emphasis on demand, and the fact that demand has become the engine of economic advance, moving entrepreneurs and inventors into the search for new modes of productivity, new combinations of materials and markets, new sources of supply, and new modes of innovation. The re-entry of a destroyed Germany and Japan into the world economy; the rapid industrialization of Brazil, Mexico, Taiwan, Korea, Algeria, South Africa, and similar countries; the expanding world trade of the Soviet-bloc countries—the revolution of rising expectations and the urge to get into the middle class—have all produced this extraordinary synchronization. Yet, while we have the genuine foundations of a world economy, we evidentally lack those cooperative mechanisms which can adjust these different pressures, create a necessary degree of stabilization in commodity prices, and smooth the transition to a new international division of labor that would benefit the world economy as a whole. We shall return to this below.

IV

If one looks ahead to the next decade, there are four structural problems that will confront the advanced industrial societies in the effort to maintain political stability and economic advance.

1. *The double bind of advanced economies.* The facts that every society has become so interconnected and interdependent and that the political system has taken on the task of managing, if not directing, the economy mean that, increasingly, "someone" has to undertake the obligation of thinking about the system "as a whole." When the economic realm had greater autonomy, the shocks and dislocations generated through the market could be walled off, or even ignored—though the social consequences were often enormous. But now all major shocks are increasingly *systemic*, and the political controllers must make decisions not for or against particular interests, powerful as these may be, but for the consequences to the system itself.

Yet that very fact increases the inherent double bind in the nature of a democratic or responsive polity. For the state increasingly has the double problem of aiding capital formation and growth (*accumulation*, in the Marxist jargon) and meeting the rising claims of citizens for income security, social services, social amenities, and the like (the problem of *legitimation*, in Max Weber's terminology).

In one sense, this is the fulfillment of a different kind of prediction made by Marx. Already in 1848 to 1849, when he was engaged in political activities in Cologne, he said that once the "democratic revolution" (i.e., the achievement of the franchise and other civil rights) was achieved, the "social revolution" (the transformation of society) would follow. This was the basis for his "right-wing" and "coalitionist" tactics toward the democratic (i.e., bourgeois) groups at the time. What is striking is how long it took for Marx's prediction to come true. The electoral franchises were secured, in most Western European countries, only by the end of the century, and it took 50 years beyond that (facilitated by the structural changes in the economy) for democratic pressure to be turned into social leverage.

In practical fact, this major change has resulted in the sharp rise in governmental expenditures over the last 40 years and in social expenditures in the last decade and a half. Since 1950, the growth in public expenditure, per year, has been between 4.3 per cent in Great Britain, at the low end of the scale, to 11.6 per cent for Italy, at the high end. In these years, the growth in GNP has been from 2.8 per cent a year in Britain to 5.7 per cent in Germany. (Italy was growing at 5.3 per cent a year.) As a share of GNP, public expenditure varies from 30 per cent of GNP in France to 64 per cent in Sweden, which has experienced the highest growth in the 25-year period. (Italy's public expenditure is 58 per cent of GNP, Britain's is 53 per cent, and the United States' is 38 per cent.)

These rates of growth of public expenditures over a quarter of a century, in countries such as Great Britain and Sweden—almost 50 to 75 per cent greater than the growth of GNP—raise some complex economic and social questions. Direct comparisons on the basis of *growth rates* are difficult, since some nations started from a low absolute base of public expenditure. It is too easy to say, as some conservative economists do, that public expenditure is eating up the national patrimony. And it is hard to calculate how much the expenditures on education and health increase the skills and capabilities of individuals in the society. With all that, some questions remain. The Oxford economists Bacon and Eltis have argued that expenditures in the public sector are, inevitably, of lower productivity than a comparable amount spent in the private sector, and that these differential rates account for the slowdown of the British economy. And if these rates of growth of public expenditure continue, who will pay for them? If they cannot be financed from economic growth, then they have to be financed by higher taxes, by inflation (a disguised form of taxation), or by external borrowing.

A recent group of theorists has sought to draw some larger consequences from this state of affairs. Richard Rose calls it "over-load"—the condition in which expectations are greater than the system can produce—and speculates whether nations can go bankrupt. Jurgen Habermas calls it a "legitimation crisis," putting it into the larger philosophical context of political justifications. Under the prevailing tenets of the liberal theory of society, each individual is free to pursue his own interests and the rule of law is only formal and procedural, establishing the rules of the game without being interventionary. But the emerging system of state capitalism lacks the kind of philosophical legitimation that liberalism has provided. Samuel P. Huntington and Samuel Brittan have argued that democracies are becoming increasingly ungovernable, because the "democratization of political demands," in the Schumpeterian sense of the term, is subject to few constraints, or fewer than those represented by the limited credit available to individuals or firms that at some point would have to pay their debts, rather than "postpone" them by increasing the public debt.[9]

I think these diagnoses are all accurate but partial. For the issue concerns not only the democracies but *any* society which seeks economic growth, yet has to balance the needs (if not the public demands) of its citizens for satisfactions and security. The Soviet Union could emphasize growth (a naked "primitive accumulation," in Marx's very sense of the term) by promises of a utopian tomorrow, the brutal repression of its peasants, and the direct and indirect coercion of its workers. But how long could this go on? It is evident that the next generation of Soviet rulers will face more and more demands, open or disguised, for the expansion of social claims, as well as for some influence (particularly among the managerial elites) over the allocation of state budgets.

The problem already exists in Poland, where Gierek—who in that sense faces the same problems as Denis Healey—has to worry about capital formation for the renovation of Polish industry, yet maintains high prices for peasants as inducements to produce, and food subsidies for workers to keep *their* prices down. When he sought to realign the system by raising food prices, as economic logic compelled him to, he had almost a full-scale revolt by the workers on his hands. In fact, one can say that Poland is probably the only real Socialist government in Europe since it is the government most afraid of its working class.

If one searches for a solution, the double bind manifests itself in the fact that inflation or unemployment have become the virtual trade-offs of government policy, and governments are in the difficult position of constantly redefining what is an "acceptable" level of unemployment and an "acceptable" level of inflation. It is compounded by the fact that where there are deflationary pressures, particularly within declining economies, every group seeks to escape the necessary cut in its standard of living or its wealth, so that the pressures toward a greater corporate organization of society (and the ability to use that corporate power for wage indexing or tax advantages) increase, and the heaviest burdens fall on the unorganized sections of the society, largely sections of the poor and the middle classes. The final irony is that with all the money being spent on social expenditures there is an evident sense that the quality of the services is poor, that the social-science knowledge to design a proper health system, or a housing environment, or a good educational curriculum, is inadequate, and that large portions of these moneys are increasingly spent on administrative and bureaucratic costs.

2. *Debt and protectionism.* Almost every Western society, as a result of Keynesian thinking, has stimulated its economy in the last 40 years by means of deficit financing and pump priming (or in the newer, fashionable phrase, "demand management"), with the result that it has incurred ever deeper debts.

According to the earlier theorists of "functional finance," such as A.P. Lerner, debt meant very little in economic terms so long as (a) the amount of debt service was manageable and did not become too large a lien on the society, and (b) a nation could not go bankrupt since it owed the money, really, to "itself" and could always reduce the debt if necessary, so long as it had effective taxing power. In fact, the theory went, a nation, like a giant utility company, would never even "redeem" its debt but continue to roll it over in new borrowings, so long as the debt management level was within "reasonable" limits—an "acceptable" level which, like that of inflation and unemployment, was constantly being redefined.

The difficulty in most countries today is that not only has the "internal" debt level been mounting steadily, but there is also a rising "external" debt which presumably has to be repaid at some point. And it is the combination of the two which seems so threatening to the stability of the international monetary system.

The major problem is the growth of external debt. To meet its obligations, Great Britain has now borrowed about $20 billion dollars, quite a low figure compared to its internal debt. Yet that money has to be repaid. To obtain money from the International Monetary Fund (IMF), Britain (like Italy, which is in a similar situation) has had to comply with various stringencies imposed by the IMF as its ''price'' for the loan, one of these being even larger cuts in public expenditures than the Labour party had planned.

But the question of external debt is a minor one, as yet, for the advanced industrial societies. The heaviest burdens fall on the non-oil-producing less-developed countries, about a hundred in number. A conservative estimate by the Organization of Economic Cooperation and Development (OECD) in its Economic Outlook of December 1976 puts the figure at roughly $186 billion (some estimates go as high as $220 billion), most of this incurred in recent years as a result of the rise in oil prices. Projections of that debt in 1985 go from nearly $350 billion to $500 billion. For these countries, the ratio of *external* debt to GNP is about 25 per cent; by 1985 it would rise to 45 per cent.

If one takes the conservative figure of the aggregate external debt in 1976 as $190 billion, the deficit trade balance (imports over exports) is about $34 billion, and the debt service about $13 billion. This makes, for 1976, a total of $47 billion as the amount of *additional* external borrowing required. If one takes the scenario to 1985, and an external debt of $500 billion, the projected trade deficit would be $52 billion and the debt service $34 billion, or a requirement of $86 billion in that year from the ''richer'' countries.

How can this be done? In 1974 to 1976, two-thirds of the Third World's borrowing (of $78 billion) was financed by the recycling of petrodollars through the Western banks. But how long can this continue? Any new loans would have to come from international agencies such as the IMF. But one of the conditions that the IMF usually imposes is that debtor countries reduce or eliminate their payments deficits—and this can be done only by the sizable reduction of imports.

In effect, the very discipline that an IMF would impose could only lead to a heightened economic nationalism and protectionism. This is the very prescription that the British Labour Left (aided by the thinking of the ''new'' Cambridge school of economists, Wynne Godley, Michale Posner, and Robert Neild) has put forward. Import restrictions, they argue, are preferable to cuts in public expenditure. Too many of the ''wrong'' things are being imported and, besides, if import controls were being established, domestic industry would take up the slack and produce the necessary items that are now being imported (such as more British cars).

The British Left is advocating a ''siege economy.'' But the pressures for protectionism are evident in almost every country that is feeling the shock of dislocations under competitive pressures. Japan, as every country knows, has subtly kept many foreign products outside its home market, while allegedly ''dumping'' various products onto other markets. The United States has begun retaliating by raising the tariff on Japanese television sets. American trade unions, once largely for free trade, are now completely protectionist, and the maritime unions have often been successful in their demands that various subsidized exports be carried in American bottoms.

The 1929 world depression came when Britain decamped from international free trade and instituted ''imperial preference''; actions soon followed by other countries, such as the United States, going off the gold standard and imposing export controls on capital. None of the present-day pressures exist on the same scale. But there is a great temptation for many countries, Britain included, to have a go at the game of protectionism. As *The Economist* (February 26, 1977) recently commented:

> Economic nationalism will develop first among the poor and the weak, the countries with the largest trade deficits which have least to fear from retaliation. Their governments will put on import restrictions, because they fear to impose socially disastrous and politically dangerous austerity measures at home. The first in this field will gain. But for the world as a whole this will be a negative-sum game. The result will be a further period of serious international recession until inflationary pressures have been purged from the system. When, where and how quickly will this happen?

3. *The demographic tidal wave*. The third structural problem derives from demographic change, particularly in Latin America and Asia. Most demographic discussions have focused on the problem of the size of the world's population by the year 2000—whether it would be six

Area or Country	Population 1975	Population growth rate	% Urban	Inflation rate	Population under 15 (%)
Latin America	327.6	2.9	60.4		43
Mexico	59.3	2.4	63.2	22.5	48
Brazil	113.8	2.9	59.5	32.7	42
Columbia	24.7	3.2	61.8	31	47
Venezuela	12.0	2.9	82.4	11.9	45
Chile	10.7	1.9	83.0	365	40
Argentina	25	1.5	80		29
Asia	2,407.4	2.5			
India	636.2	2.6	21.5	31	42
Bangladesh	79.6	3.0	6.8	100	45
Pakistan	71.6	3.6	26.9	*	44
Indonesia	137.9	2.7	19.3	34.4	45
Philippines	44.7	3.2	36	30	43
Thailand	42.3	3.1	16.5	21.3	46
China	942	2.4	23.5	*	36
Japan	111.9	1.3	75.2		24
Africa	420.1	2.8	24.5		44
Nigeria	81.8	2.5	23.1	12	45
Ethiopia	28.8	2.6	11.2		45
Zaire	24.9	2.8	26.2	29.3	44
Egypt	37.2	2.2	47.7		42
Algeria	16.8	3.3	49.9		47
Europe (excluding USSR)	474.2	0.8	67.2		26
United Kingdom	56.2	0.2	78.2		24
France	53	0.8	76.1		25
W. Germany	62.6	0.5	83.4		23
E. Germany	16.8	−0.4	74.9		21
Poland	34.0	0.9	56.5		25
USSR	254.3	0.9	60.5		29
USA	219.7	1.0	76.3		27

*Not available.

billion or seven billion, and whether the world could sustain those numbers. But in any immediate sense, the year 2000 is not the issue. A scrutiny of the accompanying table shows what *is* urgent: *the percentage of the age cohort now under 15 years of age*. This is a group already alive, which within the next decade will flood the schools and labor markets of the less-developed countries.

If one recalls the events of the 1960s in the West, much of the student unrest was due (not as a cause, but as a condition) to the tidal wave of young people that rolled through the universities in the middle and late 1960s. In the United States, for example, there was no increase at all in the proportion of young people between 17 and 22 in the 1940 to 1950 decade, and no increase at all in the proportion of young people in the following decade. Yet from 1960 to 1968, reflecting the "baby boom" of the early postwar years, the proportion of young people jumped more than 50 per cent. What one found was an increasing self-awareness of the group as a separate "youth culture" (and youth market), an increasing competitiveness to get into the good schools, and, owing to the draft, into graduate and professional schools. This large expansion of an age cohort, combined with the moral ambiguity of the Vietnam war, turned a large part of this generation, particularly its elites, against the society. And a similar process occurred in Western Europe.

If one looks ahead to the next decade, what is striking is the extraordinarily high proportion of young people in Latin America (with the exception of Argentina), Asia (except Japan), and Africa. In Europe, during the 1960s, the large number of "surplus" workers in Turkey, Yugoslavia, Greece, and southern Italy could be drawn "north" by the expanding economies of the Western European tier. (Now large pockets of such workers remain, creating a growing problem for these countries, such as the Turkish knots in West Berlin.) But where will the "surplus" populations of the developing world go in the coming years? The problem is compounded by the fact that there already exists in Latin America a high degree of urbanization, high inflation rates, and high unemployment or underemployment rates. Both Mexico and Brazil, whose industrial production have been growing at the astounding rates of between 12 and 15 per cent a year, are by now almost at the peak of their potential. Yet both face a doubling of the entry rate into schools and the labor force in the next decade.

Mexico, with its highly concentrated population in the Federal District of Mexico City-which contains about a fourth of the entire population of Mexico—is an especially sensitive case. In 1920, Mexico had a population of little more than 14 million persons. Fifty years later, it was more than 60 million (or more than almost every country in Western Eurpoe), and by the end of the century it will probably have at least 100 million persons. The United States is belatedly waking up to the problem of millions of illegal aliens flowing across the border and finding sleazy jobs in small service and manufacturing establishments whose owners welcome the cheap, exploitable labor, since they need not pay large social fringe benefits, and the workers have to be docile lest they be deported. But what is the solution? Is one to string barbed wire across two thousand miles of border? Or engage in periodic dragnets in the major cities of the country? And can Mexico itself, facing these explosive problems of population, escape the risks of military dictatorship when its problems become "unmanageable"? What will foreign capital do under those circumstances? Can any of these questions be met without some form of international migration policy?

4. *Rich and Poor Nations.* The rich and the poor may always be with us, but in what proportions? One of the most striking facts about the period since World War II, in terms of its psychological impact, has been the growth in the world's middle class—using the term, crudely, to mean those who could purchase domestic electrical appliances, have a telephone, buy a car, use a stated amount of energy per capita, etc. According to the calculations of Nathan Keyfitz, between 1950 and 1970, the middle class grew from 200 million to 500 million persons—to about 12.5 per cent of the world's population, or more than 40 per cent if we assume that this growth was largely within the rich and middle income countries.[10] If we were able, in the next 20 years, to maintain that rate—4.7 per cent a year achieved in the best period we have seen in world economic history—about 15 million of the 75 million persons who are being added to the world's population each year would be added to the middle class. But the remaining 60 million would be poor.

Of the many important issues between the rich and the poor nations, perhaps the most sticky, and the real time bomb in international economic relations, is that of industrialization. The goal of the developing countries, stated in the UNIDO Declaration and Plan of Action on Industrial Development and Co-operation issues agreed in Lima in 1975, is that *by the year 2000, the developing countries should account for at least 25 per cent of the world's industrial production*. It is typical of the rhetoric that in the Lima Declaration the term "industry" was not defined, nor was it specified whether "industrial production" means *gross* or *net* industrial output, nor was there even an unambiguous definition of what constituted the group of developing countries!

However, at the United Nations Conference on Trade and Development (UNCTAD) meeting in Nairobi in May 1976, a more serious and specific effort was made to spell out the implications of that target. The paper presented to UNCTAD considers manufacturing only (excluding mining, electricity, gas, and water), defines production as *net* output (value added, or the sector's contribution to Gross Domestic Product), and includes Yugoslavia and Israel within the definition of developing countries.[11]

Taking the growth rates of manufacturing output for the developed-market economies and for the countries of Eastern Europe for 1960 to 1972, the UNCTAD document projects the estimated production values from 1972 to the year 2000 *at those growth rates,* and reaches a figure of $6,500 billion in 1972 dollars. "The Lima Target," declared the document, "postulates that the share of the developing countries in world manufacturing output will increase from a share of 9.3 per cent in 1972 to 25 per cent by the year 2000 which, when applied to the figure given above, yields a value of $2,165 billion. To reach this output volume, *manufacturing output in the developing countries would* *have to maintain an annual growth rate of over 11 per cent per year—compared with the growth of 6.6 per cent attained during the period 1960-1972—or in other words their manufacturing output would have to be 20 times the output achieved in 1972.''* (emphasis added)

To put that figure in meaningful perspective, the growth rates of manufacturing output in the developed ''market-economy countries'' from 1960 to 1972 was 5.6 percent and for the ''Socialist countries'' 9.0 per cent a year. The prospect of reaching the UNCTAD target, even by radical restructuring of the composition of the manufacturing output (i.e., a shift from light to heavy industry), is clearly improbable. The UNCTAD document then draws upon another report, prepared for the International Labor Organization (ILO) conference in June 1976 on Income Distribution and Social Progress and the International Division of Labor. This document deals with the ''eradication of absolute poverty'' among the hard core of the poor, defined as the poorest 20 per cent of the world's population, and points out that to achieve this target by the year 2000 by economic growth alone would require a ''doubling of the already rapid rates of GNP growth in developing countries, a contingency that is considered unlikely.''

What, then, is the answer? The ILO report, echoed by the UNCTAD document, states that ''*if substantial income redistribution policies were introduced,* most developing countries would appear to achieve the basic needs objective by growth at an annual rate of approximately 7 to 8 per cent,'' and that ''the proposed strategy implies quite high levels of investment, without which there would be neither growth nor meaningful redistribution.'' The rhetoric is not that of the *Communist Manifesto*. Given the platforms, those of United Nations' agencies, the language is stiff and bureaucratic. Given the proponents, however, the key terms ''substantial income redistribution'' and ''high levels of investment'' have a menacing ambiguity. The point, however, is clear. Here is the agenda of international politics for the rest of the century. Whether the proponents of the ''new international economic order'' have the political or economic strength to enforce these demands, is another question.

V

If one reviews the nature of the structural situations facing the advanced industrial societies in the 1970s, what is striking are the parallels to the 1920s and 1930s. If one looks at the period not in terms of the character of the extremist movements of the time, but to understand why the Center could not hold—from the vantage point of the governments, so to speak—there were four factors that, conjoined, served to reduce the authority of the governments, imperil their legitimacy, and facilitate the destruction of these regimes. These were:

- The existence of an ''insoluble'' problem.
- The presence of a parliamentary impasse with no group being able to command a majority.
- The growth of an unemployed educated intelligentsia.
- The spread of private violence which the ruling regimes were unable to check.

In that period, the ''insoluble'' problem was unemployment. No government had an answer. The Socialists, when in office, as in Germany in 1930 or England in 1931 could only say (as did Rudolf Hilferding, the most eminent Marxist economist of the time, who served as a minister in the Müller cabinet in 1930) that under capitalism the state could not intervene and one had to let the depression run its course. In England, as Tom Jones, the friend of Ramsay Macdonald, confidant of Stanley Baldwin, and a member of the key Unemployment Board with Sir William Beveridge, noted in his *A Diary with Letters,* no one at the time knew what to do.

The parliamentary impasse arose out of the polarization of parties and, in the Latin countries, the unwillingness of the Socialist parties to enter ''bourgeois governments'' lest they be co-opted (as a large number of French Socialists from Briand to Mitterand have been) and leave the Socialist movement. Thus in Spain, in Italy, in France, the parliaments were in shambles.

The unemployed intelligentsia consisted of lawyers without clients, doctors without patients, teachers without jobs, the group that Konrad Heiden, the first historian of National Socialism, was to call ''the armed Bohemians.'' The entire first layer of the Nazi party leadership, Goebbels, Rosenberg, Strasser, were of this stripe.

The spread of private violence arose out of the private armies of the extremist groups—the Black Shirts, the Brown Shirts, the Communists, with their own grey and red uniformed detachments, and even the Socialists with their Schutzbund in Austria—and the efforts of these groups to control the "streets" and carry out their demonstrations.

The result, of course, was the rise of authoritarian and Fascist regimes in Portugal, Italy, Germany, Austria, and Spain, and the menacing threat of Fascist movements in France (de la Roque and the Cagoulards), in Belgium (Degrelle), and the Great Britain (Mosley). In these instances, the decisive support came from the middle class, which feared being declassed, and the traditionalist elements, which feared the rising disorder. When Hans Fallada asked, in the famous title of his novel, "Little Man, What Now?" the answer was a right-wing reaction as preferable to left-wing Bolshevism. The Center no longer had a chance in most of these countries.

If one looks at the situation in the 1970s, there are some sinister parallels. The insoluble problem is inflation. Few of the economists, once so sure of their mastery of policy, now can agree upon an answer; and to the extent that there is one, it is reminiscent of the old answer of Hilferding: a deflationary policy that takes its toll by unemployment. To reduce the fever, one resorts to amputation. With continuing or a yo-yo inflation, there is rising anxiety, especially in the middle classes. With high levels of unemployment, the young, the blacks, and the poor suffer most.

The parliamentary impasse is reflected in the fact that there is not a single majority government in Western Europe. Every country is ruled by a coalition of parties, no single one of which commands a majority on its own. In England, France, and Italy the ruling governments are led by minority parties that often dare not act, or cannot govern effectively.

The increase in the educated intelligentsia is an obvious fact in every Western country, a product of demographic idiosyncracy and deflationary cuts in public expenditures, but an explosive force no less, as is being shown in Italy today.

The private violence of the 1920s and 1930s is replaced by urban terrorism, fitful and sporadic in most cases, yet sufficiently menacing in Northern Ireland to turn that country into a garrison state.

No parallels are ever historically exact, and they can mislead as often as help, as we have seen by the occasions when words like "Munich" or the "betrayal of Ramsay Macdonald" are invoked. Yet, distorting mirrors though they may be, they allow us to see what may be similar and what may be different.

Even with the growing anxieties of the middle class, as in Denmark and Sweden and England, and, less obviously, in France and Italy, it is highly unlikely that any of the European countries will go Fascist, or see a strong right-wing reaction. These movements are too discredited politically and would lack any historical legitimacy. What is more likely to happen in Europe, as well as in many other countries, is *fragmentation*—both in geographical terms and as a result of the unraveling of the society in functional terms.

There are two reasons for the greater possibility of fragmentation as the likely response in the coming decade, and they are clearly visible. One is that most societies have become more self-consciously *plural* societies (defined in ethnic terms) as well as *class* societies. The resurgence of minority-group consciousness in almost every section of the world—in national, linguistic, religious, and communal terms—shows that ethnicity has become a salient political mechanism for hitherto disadvantaged groups to assert themselves. The second reason is that in a world marked by greater economic interdependence, yet also by a growing desire of people to participate at a local level in the decisions that affect their lives, *the national state has become too small for the big problems in life, and too big for the small problems.* In economic terms, enterprises seek regional or transnational locations, moving their capital and often their plants where there is the greatest comparative advantage. In sociological terms, ethnic and other groups want more direct control over decisions and seek to reduce government to a size that is more manageable for them.

The threat of *geographical* fragmentation can be seen in the United Kingdom, with possible devolution for Scotland and Wales; in Northern Ireland, with the bitter religious fratricide; in Belgium, with the traditional enmity of the Flemish and the Walloons; in Canada, on the linguistic issue between the French in Quebec and the English-speaking groups in the other provinces; in France, where there are small separatist movements in Corsica and Brittany; in Spain, with the traditional claims for Catalonian and Basque autonomy; in Yugoslavia, where there are the smoldering rivalries of the Serbs, Croats, Slovenes, and Montenegrins; in

Lebanon, where the binational state has fallen apart and become a client of Syria. Pakistan split apart into West Pakistan and Bangladesh. Nigeria has just survived a civil war, overcoming the threat of Biafran succession. In various African countries, in the landlocked areas of the Sudan, and Rwanda-Burundi, whose tribes and peoples are being quitely slaughtered, almost unnoticed.

Nor is the Soviet bloc immune. Politically, there has been a very real fragmentation in the loss of the earlier Stalinist hegemony over the countries of Eastern Europe and the European Communist parties. The unrest is ever latent in Poland and in Czechoslovakia. Within the Soviet Union, there is the evident unease at the shifting demographic balances that, by the year 2000, will make the Great Russians a minority in the Soviet world, and will produce a piquant situation where three of every ten recruits for the Soviety army will be Muslim.

Functionally, fragmentation consists of the effort of organized corporate groups to exempt themselves from the incomes policies that regimes inevitably have to resort to, in one way or another—through an overt social contract or through the tax mechanism—in order to reduce inflation. There is the likelihood in many countries of the breakup of the party systems. Though such structures have a powerful life of their own, in many countries they evidently do not reflect underlying voter sentiment. In Britain, the majority of people are for the "center," yet the party machines fall into the hands of the more extreme right-wing, as in the Conservative party, or in the hands of the left-wing, as is almost the case in the Labour party. Where the party system does not break up, there is a greater likelihood of volatility, with individuals arising—as did Jimmy Carter—to present themselves as "protest" candidates, and, using the mechanisms of primaries, direct elections, and the visibility generated by the media, catapult themselves into office.

VI

Is there a way out? In principle, there is an answer. It is the principle of "appropriate scale." What is quite clear is that the existing political structures no longer match the underlying economic and social realities, and just as disparities of status and power may be a cause for revolution, so the mismatch of scales may be the source of disintegration.

What was evident in the 1930s, in a wide variety of political circumstances, was that the national state became the means to pull the economy and society together. If one looks back at the New Deal of Franklin D. Roosevelt, it was not "creeping socialism" or "shoring up capitalism" that characterized his reforms (though there were elements of both in his measures), but the effort to create national political institutions to manage the national economy that had arisen between 1910 and 1930. By shifting the locus of policy from the states to the federal government, Roosevelt was able to carry out macroeconomic measures which later became more self-conscious, particularly as the tools of macroeconomic analysis (the ideas of national income accounts and GNP, both of which were only invented in the 1940s and were introduced in the Roosevelt budget message of 1945) came to hand.

But the national state is an ineffective instrument for dealing with the scale of major economic problems and decisions which will be necessary in the new world economy that has grown up, though national interests will always remain. The problem, then, is to design effective international instruments—in the monetary, commodity, trade, and technological areas—to effect the necessary transitions to a new international division of labor that can provide for economic and, perhaps, political stability. (It would be foolish, these days, to assert that economics determines politics; but the economic context is the necessary arena for political decisions to be effective.) Such international agencies, whether they deal with commodity buffer stocks or technological aid, are necessarily "technical," though political considerations will always intrude. Yet the creation of such mechanisms is necessary for the play of politics to proceed more smoothly, so that when some coordinated decisions are taken for political reasons, there is an effective agency to carry them out.

At the other end of the scale, the problem of decentralization becomes ever more urgent. The multiplication of political decisions and their centralization at the national level only highlight more nakedly the inadequacies of the administrative structures of the society. The United States, as Samuel P. Huntington once remarked, still resembles a Tudor polity in its multiplication of townships, counties, incorporated or unincorporated villages. With such overlapping jurisdictions and inefficiencies not only are costs—and taxes—multiplied, but services continue to decline. We have little sense of what is the appropriate size and scope of what unit of government to handle what level of problem. What is evident is that the overwhelming majority of people are increasingly weary of the large bureaucracies that now expand into all areas of social life—an expansion created, not so paradoxically, by the increased demand for social benefits. The double bind of democracy wreaks its contradictory havoc in the simultaneous desire for more spending (for one's own projects) and lower taxes and less interference in one's life.

Yet here, too, there is the possibility of a way out: the use of the market principle—the price mechanism—for social purposes. As against the ritualistic liberal, whose first reaction regarding any problem is to call for a new government agency or regulation, or the hoary conservative who argues that the private enterprise system can take care of the problems (it often cannot, for some coordinated action by a communal agency is necessary), one can use the market for social purposes—by giving people money and letting them buy the services they need in accordance with their diverse needs, rather than through some categorical program.

. . . In a world where, at the large and small ends of the scale, social stability is threatened and governance becomes difficult, questions of domestic and foreign policy quickly intertwine. For if the national state is too small for the big problems of life and too big for the small problems, we have to begin to think—and, given the shortness of time and the specter in the streets, to concentrate the mind, as Dr. Johnson would have said—about what other political arrangements may be necessary to give us stability and freedom in this shrinking world.

NOTES

[1]This, as well as many other striking insights, is to be found in the neglected book of Brooks Adams, *The New Empire* (New York: MacMillan, 1902), a powerful history of the rise and fall of empires in response to the changing trade routes, the exhaustion of metals and resources, and the intersecting influences of geography and technology.

[2]UNCTAD *Statistical Handbook,* 1973.

[3]See Richard Jolly, "International Dimension," in Hollis Chenery, et. al., *Redistribution with Growth* (New York: Oxford University Press, 1974).

[4]So rapid was this political change that most persons do not know that the issue which threatened to split the Socialist International in the 1930s was the question (summed up in the so-called Bauer-Dan Zyromski theses) of entering "bourgeois coalitions."

[5]If one reviews the sociological and political literature of the 1930s, it is striking that almost none of the major works dealing with contemporary crises foresaw the change in the international system. The only country that had a "visible" independence movement was India, and it was assumed that, someday, it would achieve a greater degree of self-government within the Commonwealth framework. Almost all the preoccupations were with the threat of fascism and the breakup of the liberal bourgeois states. For a representative book of those times, see Karl Mannheim, *Man and Society in an Age of Reconstruction* (New York: Harcourt Brace Jovanovich, 1967).

[6]International money markets are now so sensitive that—as the *London Times* of November 1, 1976 reported—some 800 banks and 250 corporations, from Hong Kong to Europe and across the United States, pay £7,000 a year to be plugged into the Reuters Money Market service, a computerized electonric monitoring service on exchange rates in different world centers.

[7]I have tried to deal with the social consequences of the impact of each on the other in a monograph, "The Social Framework of the Information Society," for the Laboratory for Computer Science at M.I.T. Part of that study will be included in a volume on the future of computer technology, edited by Michael Dertouzos and Joel Moses, to be published by the M.I.T. Press in spring of 1978. A different section appears in *Encounter,* June 1977. See also Daniel Bell, *The Coming of Post-Industrial Society* (New York: Basic Books, 1973); also a paperback version (New York: Basic Books, 1976) with a new introduction.

[8]For the origin and development of Schumpeter's idea, see Daniel Bell, "The Public Household—on Fiscal Sociology and the Liberal Society," in *The Public Interest,* Fall 1974. A variant version of that essay is included in Daniel Bell, *The Cultural Contradictions of Capitalism* (New York: Basic Books, 1976).

[9]See Richard Rose and Guy Peter, "Can Government Go Bankrupt," unpublished paper, December 1976, to appear in a volume of the same title by Basic Books in spring 1978; Jurgen Habermas, *Legitimationsprobleme in Spätkapitalismus* (Frankfurt, 1976. English translation, *Legitimation Crisis,* by Beacon Press, 1976); Samuel P. Huntington, "The Democratic Distemper," in *The Public Interest,* Fall 1975; and Samuel Brittan, "The Economic Contradictions on Democracy," in the *British Journal of Political Science,* 1975, no. 2. For a neo-Marxist view, see James O'Connor, *The Fiscal Crisis of the State* (New York: St. Martin's Press, 1973), and, for an effort to put the economic issues in a cultural as well as political context, Daniel Bell, *Cultural Contradictions of Capitalism* (New York: Basic Books, 1976).

[10]See Nathan Keyfitz, "World Resources and the World Middle Class," *Scientific American,* July 1976.

[11]United Nations, Secretariat, Conference on Trade and Development, *The Dimensions of the Required Restructuring of World Manufacturing Output and Trade in order to Reach the Lima Target,* Supp. 1 (TD/185), April 12, 1976.

Bottle babies: death and business get their market

LEAH MARGULIES

■ Leah Margulies *has been a coordinator of the Infant Formula Campaign since 1975. She has long been interested in the dynamics of market expansion by Western corporations into Third World countries, and especially in the marketing of Western middle-class products to poor people in the Third World. She is now co-authoring a book about the baby-formula controversy.*

In "Bottle Babies: Death and Business Get Their Market," *Margulies provides a bleak account of the attempts made by Nestlé and other corporations to replace breast feeding with bottle feeding among the poor of the Third World. She describes the suffering, malnutrition, and death caused by the Nestlé infant formula campaign, as well as the dilemma of the hospitals and physicians who co-operate with Nestlé in exchange for sorely needed medical equipment. "Because of . . . growing condemnation of industry practices, the companies have made some attempts to deal with their critics. In most cases however, the concessions do not significantly alter the outcome of formula promotion." She points out that the profits from infant formula sales in the Third World run quite high.*

Caracas, Venezuela, July 1977: In the emergency room of the Hospital de Niños, a large facility in the center of the city, lie 52 infants. All are suffering from gastroenteritis, a serious inflammation of the stomach and intestines. Many also suffer from pneumonia. According to the doctor in charge, 5,000 Venezuelan babies die each year from gastroenteritis, and an equal number die from pneumonia. The doctor further explains that these babies, like many who preceded them and those who would follow, have all been bottle-fed. He remarks, "A totally breast-fed baby just does not get sick like this."

Poverty, inadequate medical care, and unsanitary conditions make bottle feeding, to quote a government nurse in Peru, "poison" for babies in the developing countries. Yet bottle feeding is rapidly becoming the norm in Third World countries. In 1951, almost 80 percent of all three-month-old babies in Singapore were being breast-fed at the age of three months; twenty years later, only 5 percent of them were at the breast. In 1966, 40 percent fewer mothers in Mexico nursed their six-month-old babies than had done so six years earlier.

The end result of this significant change in human behavior is higher morbidity and mortality rates among bottle-fed babies. Many well-known studies provide evidence of the relation between bottle feeding and infant malnutrition, disease, and death. Of course, it is impossible to know how many babies are getting sick or dying because of bottle feeding, but the number is large and growing throughout the developing world. Dr. Derrick Jelliffe, head of the Department of Population, Health, and Family Planning at the UCLA School of Public Health, conservatively estimates that about 10 million babies a year suffer from malnutrition related to bottle feeding. The phenomenon is literally worldwide. According to medical reports of malnutrition among Eskimo children in the Baffin Zone of Canada, almost 5 percent of the infants born there in 1973-74 had to be flown to Montreal for emergency treatment, and doctors believe that one of the major causes of this tragic development was bottle feeding.

At the center of the bottle-feeding controversy are the promotional practices of the corporations who sell bottles and powdered baby milks in the Third World. Critics believe that promotion of these powders to mothers who do not have the facilities to properly prepare the feeds is a deadly way to make a profit. However, despite the increased activity of critics and acknowledgments by industry that improper bottle feeding can be dangerous, sales of infant formulas in poor countries are still escalating.

The corporations that sell infant formula in the Third World run the gamut from prestigious American, Swiss, British, and Japanese multinational corporations—like Abbott, American Home products, Bristol-Myers, Nestlé's, and Cow and Gate—to local fly-by-night manufacturers trying to cash in. The concentrated campaign to attract Third World consumers began in the late 1950s. Soon a body of literature arose to help business conquer this almost virgin territory. For example, various articles advised foreign marketers that, in the absence of a middle class, they should consider the urban poor as an important potential market.

Business began to understand the market potential of a poor population with many unful-

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filled needs. Often the real needs of the poor could be obscured by a corporate sales strategy which promised the satisfaction of newly created needs. Mass media—TV, radio, and newspapers—could convey the promise that new products would meet these new needs. *Fortune* magazine heralded this new age with an article entitled, "Welcome to the Consumption Community." It was therefore not surprising that when the "Community" of infant formula consumers in the United States began to shrink as postwar birth rates declined and middle-class women in the developed countries decided they had been deprived of the experience of breast-feeding and began turning to the more natural way, the corporations turned to the ripe Third World market.

For the companies, baby formula sales strategies have paid off. Unfortunately no reliable statistics on infant formula sales are publicly available, although sometimes companies have inadvertently revealed the extent of their commitment to the product. World-wide sales of formula are estimated to total around $1 billion, with Nestlé's figure at roughly $300-400 million. Nestlé reportedly controls approximately half of the formula market in developing countries.

Whatever the sales figures at present, they will undoubtedly increase in the future. Bristol-Myers, for instance, has consistently reported sales gains for its Enfamil infant formula. Moreover, the upward trend, for the other companies as well as for Bristol-Myers, shows few signs of abating. Of course, sales figures do not tell the full story. Profit rates for infant formulas are also thought to be quite high. According to a 1977 supermarket sales printout from Brazil, commercial formula enjoyed a 72 percent profit margin, while all other supermarket products ranged between 15 percent and 25 percent.

WHAT IS IT?

What kind of product is infant formula? It is a highly processed food, based primarily on cow's milk. While the fat content and sugar source are patterned after mothers' milk, the company's claim that it is "nearly identical to mother's milk" is ridiculous. Maternal milk is a living substance, unique in many ways. Besides supplying the proper quantities of protein, fats, and other nutrients, it protects the infant from disease by providing antibodies important to the development of the immunization system. Formula does not have the digestibility of mothers' milk. Sometimes the product is sold premixed, but in the Third World it is more often sold as a powder that requires measured amounts of *pure* water for the proper reconstitutions. Sterilized bottles and nipples are also necessary.

There are a number of reasons why infant formula sells so well in the Third World. A mother in a developing country often finds herself in situations totally unlike those her mother ever experienced. She may, for instance, work outside the home, listen to the radio, or watch TV. These situations can be disorienting, and new values and attitudes must be formed in order to deal with them. Newly acquired values such as social mobility, as well as a high regard for modern products and medical expertise, make her a particularly vulnerable target for sophisticated formula marketing campaigns. The smiling white babies pictured on the front of formula tins can lead her to think that rich, white mothers feed their baby this product and that therefore it must be better.

Going into a hospital to give birth can be an especially frightening situation for a young Third World woman. Since in many countries only a small proportion of women attend the prenatal clinic (if there is one), a mother's maternity stay may be one of the few times in her life that she will go into a hospital. Any products given to her in this environment will seem to carry medical endorsement.

Imagine the reaction of a Third World mother in her home, or a group of mothers in a clinic or hospital attending a class, to a woman in a crisp nurse's uniform. The woman may or may not be a nurse. She begins her speech, tactfully enough, by reassuring them that "breast is best," but she ends by extolling the virtues of her company's product over the natural method. Capitalizing on the respect given a nurse, the use of a "milk nurse" implies a connection between the health care profession and the commercial product.

In developed and developing countries alike, one of the hospital practices most damaging to breast-feeding efforts—and one implicitly supported by company promotional practices—is the separation of mothers and infants shortly after birth. During the twelve to forty-eight hours of separation, the infants are bottle fed in the nursery. Mothers are sometimes given antilactation shots during this period. Thus when a mother is finally reunited with her baby, switching from bottle to breast is made more difficult.

Furthermore, if the hospital has no incentive to teach her, the woman is even less likely to breast-feed. Formula companies create a strong climate for their products with their constant offers to set up bottle sterilization and preparation facilities, to equip nurseries, and to provide free supplies of formula. Busy doctors and nurses are led to adopt the postnatal separation strategy by the willingness of formula companies to make this approach easier than breast-feeding.

Medical personnel are a prime target for promotion because they are the direct link to mothers. Although it is the patient who ultimately pays for the product, doctors tell her what to buy, and the difference in backgrounds of doctor and patient may well lead to an inappropriate choice. As Dr. John Knowles, president of the Rockefeller Foundation, stated in a letter to the chairman of Bristol-Myers:

> The problem is not a 'scientific' one. The problem is poverty and the inadequate home environment which makes the use of prepared formulae so lethal. This the physician is *not* uniquely qualified to understand. In fact, he may be precisely the most unqualified to understand, since he undoubtedly comes from a different socio-economic background and may have no idea of the home conditions of the poorest mothers of his own society.

Many dedicated physicians face a real dilemma when dealing with the promotion efforts of formula companies. Their hospitals and clinics are often woefully short of medical equipment and supplies. Under such circumstances, it may seem harmless, indeed charitable to agree to give away free samples of infant formula to mothers in exchange for the company's gift of medical stocks or a new nursery. One hospital administrator in Malaysia has explained. "It is a very corrupting influence. You are always aware that you could have virtually anything you ask for."

MARKETING FOR BABIES

These marketing strategies are consciously decided upon and implemented through instructions to sales personnel, milk nurses, and distributors. Note the following extract from American Home Products selling instructions for 1975:

> **Selected doctors:** 40-50 doctors per territory including 5 or 6 VIP's. These doctors should all be selected on the basis of their known influence on the selection of formula by mothers and by hospital or clinic maternity services.
>
> **Sampling:** . . . Maternity services should be given primary allocation of free samples, geared to producing potential sales.

Companies believe, and with good reason, that the product a mother goes home with is the product she will be loyal to. A 1969 study of 120 mothers in Barbados showed that 82 percent of the mothers given free samples, whether in a hospital or at home, later purchased the same brand. Thirty-two percent of them admitted that they were influenced by the free sample.

This aggressive market penetration and consumer creation are particularly destructive because they affect the most important resource developing countries have—people. In Chile in 1973 three times as many deaths occurred among infants who were bottle fed before three months old than among wholly breast-fed infants. A research team inspecting feeding bottles there discovered a bacterial contamination rate of 80 percent. Poverty and underdevelopment lead to abuse of even legitimate baby milk substitutes. Poor mothers cannot afford them in the quantities needed. Water is often contaminated, and the necessary boiling is rarely possible. Illiteracy makes it difficult to follow proper directions. Early weaning of infants from the breast to bottled infant formula is accompanied by increasing cases of diarrhea and gastroenteritis. Improperly attended—as they are likely to be due to inadequate medical care—these disorders result in many deaths.

Malnutrition is another common result and has been described as "commerciogenic malnutrition." This is not meant to imply that the manufacturers are solely responsible but simply that this type of malnutrition has nothing directly to do with underdevelopment and lack of food resources. As Dr. Michael Latham, a pediatrician and Cornell University professor of nutrition stated, "Placing a baby on the bottle in the Third World might be tantamount to signing that baby's death certificate."

A 1975 Pan American Health Organization study found that childhood deaths from malnutrition peaked in the third and fourth months of life, because of the early abandonment of breast-feeding. The study covered some 35,000 deaths in fifteen countries. Medical studies linking bottle feeding with infant mortality and morbidity cover practically all areas of the Third World and some developed countries as well. A 1977 study in Cooperstown, New York, compared 164 breast-fed infants with 162 formula-fed infants; significant illnesses increased as breast-feeding declined. In 1970 a study in Jamaica, West Indies, revealed a higher incidence of gastroenteritis in the first four months of life among partly or wholly bottle-fed babies than among breast-fed babies. Other studies have reported similar results from Chile, Lebanon, Israel, Lagos, and others.

Hospital reports and personal testimony from doctors and nurses confirm these findings. Doctors in Jamaica have reviewed the records of thirty-seven seriously ill infants admitted in 1975 into their hospital, the Tropical Metabolism Research Unit in 1975. Twenty-five of the thirty-seven patients had been fed a brand-name infant formula. The average body weight of the babies was only 58 percent of the normal value. Their families were simply not equipped to safely bottle feed. About one fifth of the mothers were illiterate. The remainder were able to sign their names but were functionally illiterate. It was highly unlikely that they would be able to read, no less understand written directions.

Nearly all the families lived in cramped, overcrowded, and unsanitary conditions, with an average weekly income of sixteen dollars. A tin of baby formula costs approximately two dollars and a baby needs two cans a week if exclusively formula-fed. Despite optimal medical care, five of these babies died. The case studies graphically show the inevitability of bottle contamination and dilution—the key culprits leading to illness and malnutrition.

Since 1970 when the Protein Advisory Group (recently dismantled) of the United Nations first met with the baby formula industry, there has been a growing international campaign aimed at stopping unethical promotional practices. In 1973, the Protein Advisory Group published guidelines for promoting infant nutrition and included the need for restrictions in advertising. In 1974, the World Health Assembly called for a critical review of company promotion, and the issue has been discussed extensively at medical conferences, international seminars, in U.N. papers, etc. Most recently, on January 31, 1978, the World Health Organization, announced, "The advertising of food for nursing infants or older babies and young children is of particular importance and should be prohibited on radio and television . . . finally, the distribution of free samples and other sales promotion practices for baby foods should be generally prohibited."

In 1975 the International Pediatrics Association issued a series of recommendations to encourage breast-feeding. The section entitled "Curtailing Promotion of Artificial Feeding" reads:

1. Sales promotion activities of organizations marketing baby milks and feeding bottles, that run counter to the general intent expressed in this document, must be curtailed by every means available to the profession, including, where necessary and feasible, legislation to control unethical practice.
2. Dissemination of propaganda about artificial feeding and distribution of samples of artificial baby foods in maternity units should be banned immediately.

In the U.S. recently, considerable interest has centered around the stockholder lawsuit against Bristol-Myers (Mead Johnson Division). The Sisters of the Precious Blood have charged the company with making "false and misleading statements" about their overseas promotion and sales of infant formula. The statements appeared in a proxy report to stockholders, which is required by law to be accurate. In May 1977, a U.S. district court judge dismissed the case, stating that the Sisters had not shown that they, as shareholders, had been caused "irreparable harm" by the alleged misstatements. The judge declined to comment on the accuracy of the company's proxy report. The nuns appealed this decision.

Then in the first weeks of 1978, the Sisters signed an out-of-court settlement with Bristol-Myers. The settlement stipulates that a report be sent to all shareholders of the company, outlining the legal action and the positions of both parties. The Sisters' statement in the report contains affidavits from five countries and an analysis of their current criticisms of company practices. The company's statement announces a more stringent interpretation of its Code of Policies and Practices and the fact that it has discontinued the use of milk nurses in Jamaica. Industry critics view the settlement as an important step toward convincing the companies that public opinion has changed the social climate in which marketing takes place: What was at one time an "acceptable" social cost no longer is the case, primarily because of increased public knowledge and protest.

The findings of the lawsuit have prompted local consumer advocacy groups in the United States to join forces in a coalition called INFACT (Infant Formula Action). These groups believe it vital to keep pressuring Nestlé—the largest manufacturer of baby formula in the Third World—to desist from its promotion tactics. The Minnesota-based Third World Institute has initiated a consumer boycott which is quietly spreading throughout the U.S. In addition, church groups, acting in their capacity as stockholders in the American companies, are continuing their efforts to further restrict the promotion these companies engage in. This year two new shareholder resolutions were filed with American Home Products and Carnation, both of whom widely advertise their condensed milk in the Third World.

Because of this growing condemnation of industry practices, the companies have made some attempts to deal with their critics. In most cases however, the concessions do not significantly alter the outcome of formula promotion. There have been a number of changes:

• After blatant advertising, especially mass-media promotion had made some of the companies highly vulnerable to criticism, these companies switched the focus of their promotion efforts to the medical profession. This new marketing approach is more sophisticated, less risky, and far more effective. Via mass media, everyone heard the message, whether they were potential customers or not. Now marketing focuses more directly on the consumer through the use of health workers. For example, in a poverty hospital in the Philippines, name tags with a prominent brand-name logo are found on each crib in the nursery. Nestlé wrist labels have also been provided. There and elsewhere, while the most blatant ads have been curtailed, direct consumer promotion continues in the hospitals themselves and appears to be sanctioned by the medical authorities.

• In the past, critics charged that companies encouraged the abandonment of breast-feeding. Now the companies agree that bottle feeding to the exclusion of breast-feeding is not desirable. They talk about "supplementation." However, mixed feeding has also been shown to be quite dangerous. Consuming smaller amounts of contaminated and diluted formula is preferable, one assumes, but it is not the answer. Furthermore, the encouragement of supplementation in fact undermines breast-feeding. According to most medical experts, supplementation negatively affects the production of human milk.

• Critics have also complained about milk nurses and the ethics involved in employing nurses as a company sales force. Again, the companies have adapted. They often change the colors of the uniforms, add belts, call them "company representatives," and may even agree to alter somewhat milk-nurse sales techniques. But visits to hospitals and homes continue, and the nurses are still being lured away from government health services.

A more significant adaptive technique is that of employing nutritionists and other highly trained professionals. In Venezuela, for example, Nestlé employs no milk nurses but several nutritionists. These nutritionists interact on a regular basis with Ministry of Health, nutrition, and hospital personnel. One Nestlé nutritionist in Caracas appears to have been totally integrated into the health care team at Maternidad Hospital as she made her rounds with the paid hospital staff. This type of interaction between government and business personnel raises serious ethical questions about the extent to which industry's point of view should be institutionalized within government health services.

• When critics argued that formula was being promoted to the poor, the companies responded that formula is priced above the income of poor people and is purchased almost exclusively by upper-income groups. But the companies have provided no evidence to confirm this argument. Indeed, there is more than adequate proof that the products are being promoted and sold indiscriminately to mothers who have neither the financial nor the sanitary facilities to use the products safely. Since July 1977 alone, documentation confirms the presence of promotional displays in markets, pharmacies, and grocery stores in the mountain villages of India, the barrios of Caracas, and the slums of Manila.

• In response to these kinds of intense promotion efforts, the critics finally called for regulation of the formula industry. The industry, in turn, has responded with "self-regulation," which mainly consists of business codes. There are now several codes of ethics, some more stringent than others. All, however, share two inherent weaknesses.

First, the codes legitimize promotion to the medical profession and characterize the latter as "intermediaries" between the baby food industry and the mother. However, given the desperate shortages of medical personnel in developing countries and the constant pressure exerted on existing workers by the companies, it is very difficult for these intermediaries to be impartial.

Second, insuring that the companies will adhere to their self-imposed restrictions is virtually impossible in the absence of regular scrutiny by an independent body. In August 1977, a Bristol-Myers milk nurse was interviewed by this author on the ward of the largest public hospital in Jamaica. The milk nurse had in her hand a list of mothers she intended to visit in their homes. She had copied the names from ward lists. In an interview just two days before, the chief medical officer of Jamaica had explained that government policy prohibited milk nurses from entering public hospitals. The milk nurse's actions were therefore doubly in violation of Bristol-Myers's code of ethics which specifically requires cooperation with government health policies as well as the solicitation of references from medical professionals for all home visits. The publicity surrounding this incident most likely influenced Bristol-Myers's decision to discontinue milk nurses in Jamaica.

Stopping the promotion of infant formula products will not, in and of itself, eliminate malnutrition. Infant formula products could still be sold under carefully controlled and supervised conditions and still be misused because the existing social and economic conditions make proper usage virtually impossible. An end to malnutrition will ultimately require massive changes in the distribution of wealth, land, and power. But that is no reason not to take intermediate steps. The shifts in promotion thus far are adaptations to a new business climate and clearly prove that the formula industry is vulnerable to pressure.

If promotion could be eliminated entirely, health care institutions and governments would be freer to develop their own capacity to handle the monumental health problems that face Third World countries. To accomplish this, the public needs a strategy. It must include the continuous monitoring and disclosure of corporate activity; cooperation between concerned health professionals, international agencies, and advocacy groups; and the development of an increasingly larger audience of people who share the belief that business must be held accountable for unethical practices, however costly and inconvenient. As Dr. Alan Jackson of the Tropical Metabolism Research Unit in Jamaica stated in a recent interview:

> When you spend your time working with children who are malnourished and you see children dying because they are either getting wrong food or food prepared improperly, it has a devastating effect on you. It's very hard to think that people who are involved in selling, encouraging people to buy infant preparation, can carry on in this kind of a way, and at the same time pretend that they are not involved in the end results, which is malnutrition, malnourished children.

Industry's new frontier in space

GENE BYLINSKY

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In the following article Bylinsky discusses the benefits that can be reaped by industry and society from locating some industries in outer space. He points out that the virtually gravity-free environment of outer space can be used to produce "no fewer than 400 alloys that cannot be made on earth because of the gravitational pull." These alloys can be used to produce, among other things, lighter cars and "featherweight metal furniture." He also notes that the gravity-free environment is more suitable for growing crystals, the material from which chips are made in electronic industries. A crystal grown in outer space is larger and more uniform. The benefits of outer space also extend to biology and medicine. "Vaccines may attain a purity not possible on earth," and hundreds of biological products that "simply cannot be synthesized or separated on earth" can be so treated in outer space.

All this, Bylinsky says, has increased the interest of industry in outer space research and has led to the allocation of huge sums of money in that area by corporations, which see an opportunity for substantial profits.

The new battle cry at NASA, only slightly amplified, is: Thar's gold in them thar stars. In the wide and starry band of near-earth space, beginning about 200 miles up and extending to 22,500 miles, where a satellite can be placed in stationary orbit rotating in unison with the earth, the National Aeronautics and Space Administration sees the possibility of an industrial bonanza. Operating in this pure and virtually gravity-free environment, factories could produce novel materials worth as much as $30,000 a pound back here on earth. Spidery, dreamlike

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power stations could collect energy from sunlight and beam it to the planet below. The freighter servicing these new industries will be the Space Shuttle, which is scheduled to make its first orbital flight this September.

So far, the reaction of earthling industrialists to all these glittering promises has been mixed—and rather muted on the whole. High-technology companies that have contracts to develop equipment and experimental manufacturing processes for NASA are naturally enthusiastic. Other corporations are apt to be poorly informed about the possibilities, and skeptical to boot. They are well aware that the space agency itself, which desperately needs a post-Apollo mission that can command broad public support, has a great deal riding on its fledgling industries in space and has been promoting them with gusto.

There is also the rather basic matter of costs. Even a simple experiment aboard the Shuttle can cost several hundred thousand dollars, while a small, automated production plant, designed to be left in orbit and serviced periodically by the Shuttle crew, would run into tens of millions. The military, or scientific researchers backed by the government, might be willing to pay fabulous sums for materials that can't be made on earth—a perfect lens for a spy satellite, say, or perfect spheres of hydrogen isotopes for use in laser-fusion research—but NASA acknowledges that the costs and risks of space manufacture are too high and too ill defined at present to interest most corporations. Robert A. Frosch, NASA's administrator, says that his job right now is "to provide access to space and to develop basic technologies, which eventual users will need to evaluate before making investment decisions."

But skepticism on the part of profit-seeking corporations can be overdone. NASA is not exactly starting from scratch out there in space; it is building on promising experiments done on prior space flights. Those tests, mainly on the Skylab and Apollo-Soyuz flights, showed that beyond the pull of the earth's gravity remarkable things happen to materials. Crystals grow more uniformly—and in some cases ten times bigger than on earth. Biological substances can be separated and sorted out much more easily, suggesting the possibility of purer vaccines and brand-new drugs. Furthermore, those earlier flights established that it is at least technically possible to create new types of glass, "super" alloys of various sorts, and materials of variable density, with properties never seen on earth. In fact, some scientists believe that the Shuttle flights will mark a milestone for human invention, comparable to the development of the vacuum pump back in the seventeenth century.

NASA considers it significant that West German and Japanese companies are more excited about the Shuttle than their American counterparts, and that the European Space Agency, an active and enthusiastic partner, has budgeted $600 million for the design and construction of the Shuttle's spacelab—more than twice NASA's own current budget for this work. At this point, in a field involving so many unknowns, perhaps the best judgment that can be made is that while few corporations will care to take a plunge into space manufacturing, no corporation affected by changes in technology can afford to ignore the new era of innovation that is about to begin.

The advantages of manufacturing in space can best be understood as the flip side of various *disadvantages* here on earth, the most important of which is gravity. Most solid materials go through a liquid, or molten, stage at some point during their creation or processing, and, where gravity exists, they must be supported by a container—a source of contaminants.

More important, gravity induces convection currents, which flow along the thermal gradients, or temperature differences, in layers of the liquid. Convection currents, being chaotic and unpredictable, often lead to unpredictable and undesirable structural and compositional differences in the solid material. Convection can create soft and mushy zones. Gravity also pulls molecules apart, leaving holes where impurities collect. If the liquid contains more than one type of material, gravity tends to separate these different materials, and the resulting solid lacks uniformity.

These adverse effects of gravity have bedeviled materials manufacturers ever since man cast the first bronze figurine, and because of them metals have never achieved the strength and other mechanical properties that theory predicts. Steels, for instance, could be anywhere from 100 to 1,000 times stronger than they are today. Blades of jet engines now fall apart at temperatures where the efficiency of engine operations would be appreciably higher. The wires in heart pacemakers and the pins in bone prosthetics—extremely expensive, not to mention traumatic to replace—fail much sooner than they should.

In the weightlessness of outer space, most of these problems in the processing of materials disappear. Strictly speaking, of course, there is no such thing as "zero gravity"—every particle and atom has an attraction for every other one. But weightlessness aboard the Shuttle will come close to that unattainable standard. When things are quiet on the Shuttle, the pull of gravity will be only a millionth as great as that on earth. When the astronauts fire small rockets to correct their course—or merely clump around in their suction-cup boots—the pull could shoot up to a thousandth of the usual earthly value. Some scientists call these fractional conditions "microgravity."

TRW, in a major study for NASA, has identified no fewer than 400 alloys that cannot be made on earth because of the gravitational pull. Many of them are metallic combinations that, like oil and water, will not mix on earth. When allowed to solidify in the weightlessness of space, they would mix down to microscale, yielding unusual strength or hitherto unrealized mechanical, electrical, and magnetic properties. Light but sturdy vehicles could be built out of such metals—tanks that would weigh no more than a car, for example, and featherweight metal furniture. A lively topic of interest to the utilities are superconducting metals that could transmit electrical energy at low temperatures with virtually no loss of power.

In certain compositional ranges, metals such as copper and lead, or aluminum and lead, would display self-lubricating properties, possibly leading to automobile engines that could last 500,000 miles and more. BMW, the West German automaker, has shown an interest in financing some experiments with aluminum-lead combinations.

Many of these materials could be produced in a mode unique to the space environment—containerless processing. This method is possible because levitation, which may have magical overtones on earth, is the natural mode of behavior for objects in space. A blob of liquid or a solid can be positioned easily with a minimum application of force in an acoustic, electromagnetic, or electrostatic field. Since second-order forces, such as surface tension, take over in space, a blob of molten material will automatically assume a spherical shape. It can then be changed into the desired shape by applying slight outside forces. Containerless processing hasn't got very far on earth because of the great forces needed. In space, even the sound from a good commercial hi-fi set would levitate a blob of steel. This conjures up visions of a with-it generation of astronauts laying back and letting the Rolling Stones do the work.

Dispensing with containers could lead to important improvements in the microstructure of tungsten, which has a melting point so high (6,170° F.) that it is particularly prone to contamination when a melt is achieved. Impurities from the crucible also have prevented the manufacture of truly pure optical glass and have greatly increased the cost of producing the high-quality glass fibers needed for the novel transmission lines being developed by A.T.&T. and others. Glasses from space, with unique refraction and dispersion qualities, have endless possibilities in lasers and other high-technology optical systems. Ralph A. Happe, a glass specialist at Rockwell International, predicts: "We'll be doubling the catalogue of the optical designer."

But the most immediately promising field for materials processing in space is the culture of crystals, which have become the sum and substance of modern electronics and electro-optics. In electronics, the principal virtue of a crystal is its ability to transmit electrons under precisely defined and controllable conditions. In optics, crystals offer better transparency than even the best glasses because variations in the amorphous structure of glass will scatter some of the light.

Crystal culture here on earth is generally not a science but an art. The specialists who grow the large, carrot-shaped crystals used to make semiconductor chips are given to bragging about their "green thumbs"—and the metaphor is not farfetched. Although crystals are not living things, they grow in a manner roughly similar to plants. They demand nourishment for instance, and will reach toward the source of food. A crystal grower, says one specialist, "adds a little bit of this, a little bit of that—it's a recipe-type operation." Those all-important impurities, called dopants, which impart the desired electronic properties to a semiconductor crystal, are difficult to distribute evenly on earth because of convection currents induced by gravity. Consequently, the yield of usable chips from a crystal is low.

What can be accomplished in space was shown dramatically aboard Skylab, where an experiment designed by Dr. Harry C. Gatos, professor of materials science and engineering at M.I.T., produced a remarkably smooth sample of indium-antimonide crystal. Measuring the conductivity of the crystal along its length, Gatos found that the electrical properties were constant. In a similar crystal grown on earth, these properties vary continuously from one end to the other. On the Apollo-Soyuz flight, he grew an equally perfect germanium crystal. Although the experiments were of necessity somewhat primitive, the results, in Gatos's words, were "way beyond expectations."

Crystal culture in space will resume with the first materials-processing flights, which are scheduled to start in 1981, and Gatos declares that he can already see profits ahead. He cites the case of gallium arsenide, which is widely used in light-emitting diodes, lasers, microwave devices, and in other high-technology products. Gallium arsenide of not very high quality sells today for $15,000 a pound. "The cost of processing it in space," says Gatos, "will eventually be a small fraction of its selling price." The space-made crystals will have a much higher yield of usable chips, he explains, justifying a much higher price for the crystal. If, as he expects, the higher quality gives birth to new applications, then the value becomes incalculable.

Another space product that may turn a profit is a tiny sphere of a rather ordinary plastic, polystyrene latex. Spheres smaller than two microns in diameter (that is, two-millionths of a meter) or larger than forty microns can be made on earth. But for complicated technical reasons, spheres in the intermediate ranges are unstable and can't be mass produced. And it so happens that scientists crave those particular sizes. If the spheres could be sprinkled into a culture before it is exposed to electron microscopy, for example, the known sizes of the spheres would permit researchers to take the exact measure of many things, from viruses to the apertures in membranes. The tiny spheres would also be useful for calibrating the electron microscope itself, as well as medical filters and other devices.

Eager to demonstrate the advantages of materials processing in space, NASA will try to produce these latex spheres right away, possibly on the first orbital test flight this September. By the third flight, the experimenters, led by John W. Vanderhoff of Lehigh University, hope to be making the spheres in batches of up to four ounces. Waiting in the wings is Accupart Laboratories, a small company in Huntsville, Alabama, founded by a retired NASA executive named Brian Montgomery, who says that he has venture capitalists lined up willing to invest $5.6 million in the making of the microspheres, which presumably will fetch a substantial premium over the $30,000 a pound that the smaller sizes sell for today.

Space holds vast possibilities for biology and medicine. Microgravity should greatly improve man's ability to separate specific cell types, cell components, cell products, and proteins. Vaccines may attain a purity not possible on earth. Earlier space flights have already yielded some clues—and some cautionary lessons, as when bacteria got into a test on salmon-sperm DNA and ate it all up.

The basic opportunity lies in the fact that hundreds of biological products simply cannot be synthesized or separated on earth—once again because convective flows produce irregular and unpredictable mixtures. Many of these desirable products are substances that the body itself makes and packages in a very complex soup of other ingredients. Urokinase, for example, is an immensely useful chemical that activates an enzyme which dissolves blood clots. Yet urokinase is manufactured by only 5 percent of all kidney cells. The Shuttle's goal is to separate these specialized cells and then establish a culture on earth, thus increasing the yield. In fact, kidney cells separated on the Apollo-Soyuz flight did produce about seven times more urokinase than usual, but for some reason, which the researchers are naturally curious to pin down, the cells stopped making urokinase when they were cultured back here on earth.

Similarly, hormones and other substances made by the body in minute amounts—the antiviral agent, interferon, for example, and the brain's own painkillers, the endorphins—could be purified in orbit. Still another key candidate for space processing is erythropoietin, a kidney hormone that stimulates bone-marrow cells into producing red blood corpuscles. So far, nobody has succeeded in extracting pure erythropoietin on earth.

Earthbound researchers have already made great progress with white blood cells, which have been found to contain whole subpopulations of substances that act as the body's immunological defenders. In the felicitous absence of gravity, scientists think they might be able to isolate new drugs that could combat such imbalances of the immune system as rheumatoid arthritis. John C. Carruthers, the director of materials processing, who spent fifteen years at Bell Labs before joining NASA last year, predicts that "one day we'll be making pharmaceuticals in space."

If the greatest advantage of space is its lack of gravity, the second most important is the purity and thinness of the atmosphere 200 miles up. Robert T. Frost of G.E.'s space division refers to these upper regions as "the world's greatest vacuum chamber." Once again, qualifications are necessary. The space around the Shuttle won't be as clean as researchers would like to have it, because trace amounts of gases from the rocket engines and debris dumped from the cargo bay will trail the spacecraft in its orbit. And even that high up there is still an atmosphere, composed of widely dispersed atoms of oxygen, which create a pressure amounting to only ten-billionths of that at sea level on earth. So NASA is thinking of building a flying shield that could be deployed at the end of a boom. As the "air" rushed past the outer edges of the shield at the tremendous speeds of space, it would create a nearly perfect vacuum behind it. Frost has suggested that in this ultra-clean environment the thin film used in solar cells might be manufactured for 1 percent of the cost on earth.

All these marvels won't be accomplished overnight. The first flight in September will be devoted mainly to checking out the systems. Next year the Shuttle will be used to launch communications and other satellites. The first spacelab, equipped for experiments in materials processing, won't go up until the twelfth flight, in mid-1981. (The public will have to wait until about that time to see the first American woman in space.) For most people, the main excitement this fall will come when the astronauts try to jockey their stubby, ungraceful craft back to a safe landing on the salt flats around Edwards Air Force Base in California.

Around 1984, the Shuttle will take up packages containing automated experiments in biology and materials processing. The astronauts will stay in the cockpit, while on-board computers, monitored by scientists in Houston, run the show. A bit later, the Shuttle is expected to take up and release a free-flying automated laboratory powered by its own solar module. Some of the scientists seem to think that the best work will be done when the machines are left alone to do their thing.

"I doubt very much that it will be optimal to have people operating any of our experiments in space," says James H. Bredt, manager of space processing applications at NASA. "The function of man in space is not routine operations but troubleshooting. When you don't have astronauts walking around in their suction-cup boots, more perfect microgravity can be maintained."

In the fourth phase of this great adventure, however, the astronauts will come into their own again. They will be needed to construct the huge stations that will beam solar power back to earth. . . . By then, NASA fervently hopes it will be less of a drain on the taxpayers. It is spending $4.3 billion this year, of which $1.4 billion can be attributed to the Shuttle. By mid-1980's, it may have become a new sort of public utility—exercising a near-monopoly on space and all the wonders that it holds, selling its services to corporations around the world. Or it might even have turned this growing business over to a private corporation. Boeing, for one, thinks that it could run the Shuttle profitably as a commercial enterprise.