VOLUME XXVIII, NO. 25
JUNE 18, 1975

THE REHABILITATION OF NATURAL PHILOSOPHY

[This review-essay by Theodore Roszak is reprinted by permission from the *Nation* for Feb. 22. Here Mr. Roszak gives attention to Lancelot Law Whyte's last (posthumously published) book, *The Universe of Experience*, issued last year by Harper & Row.]

ALTHOUGH there is much science in our world, there are not many people who deserve to be called "scientists." Most of those who go by the name are, in reality, enzymologists or plasma physicists or invertebrate zoologists or microbial cell physiologists or one of a thousand super-refined specializations. But "science" as a vision of nature in its totality—both human and physical—is the responsibility of none of these. In their twilight years, a few Nobel Laureates, secure in their professional reputation, have been known to weaken toward broader perspectives and humanistic ruminations; but not many of their colleagues take such extracurricular antics seriously. Careers in science are built on hard research, not generalized wisdom.

Lancelot Law Whyte was a scientist in the classic sense: a natural philosopher, one of the last of this endangered species. Trained in physics under the great Rutherford, he became a "dropout" (his own description) from the British scientific community in his early 20s. He was gifted, or cursed, with far too great a theoretical passion for Rutherford's sternly empirical laboratories. And he was already in the grip of a grand, holistic vision of nature. He called it "the unitary principle," and by its light he became as well versed in biology, astronomy, psychology and philosophy as in physics. If there is such a thing as the uniformity of nature—so Whyte reasoned—it can only become apparent to those who undertake the study of science as a seamless fabric; and then the unitary principle should be manifest in some simple, integrating conception that holds true in all fields.

Of course, the uniformity of nature is an article of faith which all specialists profess. But for most, it is a passive assumption, not an active commitment; they expect that *somehow* and *eventually* all the scattered little deposits of specialized data will fall into place in the big picture of nature, like the dots of color in a Pointillist painting. On the other hand, there are the reductionists, those terrible systematizers whose project is the ultimate translation of all things into the laws and probabilities of physics. With them, psychology becomes biology, biology becomes chemistry, chemistry becomes quantum mechanics, until, at last, the mind of Shakespeare emerges as "nothing but" an elaboration of scrambled electrons.

Whyte's approach was neither of these. He would not wait to see universal law pieced together out of atomistic research; he impatiently went after the big, central truth directly. Nor would he mutilate the human and organic realms of nature to fit the physicist's Procrustean bed. He did not want unity by reduction, but by comprehension. His vision was pinned to the fundamental fact of *hierarchy* in nature: the qualitative ordering of ontological levels. He looked for a truth that unified without mechanistic or materialistic distortion, something that could be independently and manifestly perceived at all levels of nature and which *worked its way up* toward completion at the higher echelons of the natural hierarchy. He found what he was after in the dynamics of form. Like Goethe, whom he regarded as his chief inspiration, Whyte was a morphologist—but on a cosmic scale.

Whyte's career was as irregular as his style of thought. To the end of his days he considered himself a theoretical physicist and did much reviewing and publishing in professional journals. But he maintained no academic connections, and

even strayed as far from the laboratory as to become a banker for a period of years, in the 1930s. In that capacity, he played a crucial role in financing the early development of jet propulsion in Great Britain. Such mavericks fare less and less well in the scientific profession in our time, especially if they turn philosophical and begin talking to the general public. In 1946, Whyte wrote *The Next Development in Man,* a book that became a great success in the United States and gave him a wide following, for the most part among artists, architects, designers, psychologists and off-beat philosophers. Paul Goodman and Frederick Perls honored him as the major theoretician of Gestalt therapy. Alan Watts and Arthur Koestler became admirers and associates. Lewis Mumford paid constant homage to the seminal character of his work. (Indeed, Mumford, Whyte and Patrick Geddes stand as the reigning triumvirate of organismic philosophy in our time.)

But such exoteric acclaim only served to freeze Whyte more decisively out of the scientific guild. Though he grounded all he wrote in challenging, well-researched and original thought on physics, biology and psychology, his head seemed to be in too many different spaces, and he did not talk enough numbers to gain professional approval. Professions, after all, exist to defend their lines of demarcation; generalists are the enemy at the frontier. Whyte was caught between two worlds. Those who respected his work were not competent to judge or certify the advanced scientific theory on which it was based. The scientific community, whose criticism his theories needed, gave him progressively less attention. While Whyte knew a great deal more science than Arthur Koestler, his relationship with the world of science became very much like that Koestler now has. He was a knowledgeable critic, but a distinctly ignorable outsider who might act as host to conferences on fascinating new ideas in science—like the concept of hierarchy, or the internal factors in evolution—but with little prospect of professional recognition except from adventurous minds along the fringes.

I knew Lancelot Whyte during the last two years of his life. Then in his mid-70s, he was nearly old enough to be my grandfather; but we became close friends nonetheless. He was working on the final draft of *The Universe of Experience* the last time I saw him: bedridden in the hospital following a heart attack. A few months after I left London in the spring of 1972, he died. I learned from our conversations how especially frustrating these final years were for him. He painfully felt the unrelenting neglect of the scientific profession, and of the intellectual community generally in Britain. At the same time, he had become possessed by the conviction that a new generation was emerging in the United States which was peculiarly in tune with his thought and ready to be won over to the unitary principle. He was almost feverishly eager to reach that counter-cultural public with new writing and to become one of its senior mentors before his time ran out. He surely had greater claim to the role than a Buckminster Fuller or a Herbert Marcuse. His was a richer, more humanistic mind by far; and if there is an organic and holistic sensibility newly abroad, Whyte must be numbered among its major sources, even though his influence flows along subterranean currents. He needed and deserted the recognition. The day I said good-by to him, I left him a copy of *The Last Whole Earth Catalog;* in it his works (many of them now out of print) were given special mention as basic reading in the "new consciousness." He was too complimented to speak. But he has preserved his optimistic gratitude in his last book:

> I see in the youth protests of the late 1960s in America the one social encouragement of this century, for some at least of these young men and women tried to stand for the universal dignity of man, the quality of individual experience, the enhancement of living for immediacy, joy, and love. . . . If mankind comes through to hail the year 2000 it will owe this primarily to a new U.S.A., now coming into being behind all the ugliness, violence, and dominance of money, and since 1950 putting a fresh emphasis on the quality of individual experience. . . .

Whyte must have known this book would be his intellectual last will and testament. He has filled it with an aggressive, evangelical zeal. Angry impatience, especially with the state of contemporary science, and impassioned conviction permeate its pages. At times, he assumes an almost messianic air, speaking of himself as "the carrier of the universal," or, like Blake, a mere "secretary" for "the communication of a necessity." But then this is meant to be a world-saving declaration, and Whyte was a great enough mind to risk the presumption. His portrayal of himself in all he wrote was that of a man twenty years ahead of his time, appealing to bright young minds for vindication. Again and again, he banked his theories on scientific breakthroughs and cultural transformations he forecast in the generation to come. In this book, the predictive passages mount to a prophetical intensity, as if Whyte were saying: it had *better* turn out as I say, or we're all done for. He was writing beneath the shadow of a greater doom than his own death. Those who feel put off by the oracular tone should bear in mind that this is the swan song of a significant thinker, certainly one of the most gifted natural philosophers of our century.

While the book vibrates with an intoxicated urgency, Whyte has nevertheless made it an admirably succinct and rigorous statement of his scientific vision. The main idea is this:

> . . . the known universe as a whole, and every organism, including man, contains a graded sequence of units in each of which a formative tendency has been, or still *is*, present. Nature is everywhere creating forms when conditions permit, just as there is an order-generating tendency in our own minds, when not pathological, this mental tendency being a particular expression of a universal tendency. *Natura naturans* is a workshop of forms, and [my] world view of nature not only a philosophy but the basis of many future *sciences of form* in inorganic, organic, and mental nature.

Whyte pits this "universal hierarchy of morphic processes" against the entropic tendency which is conventionally held to be carrying all things inexorably toward dissipation and doom. It is one of his main purposes to dislodge the second law of thermodynamics from its central position in science. He observes the obvious, but much neglected contradiction: that in a universe supposedly governed by entropy, the two cosmologies astronomers now offer us are anti-entropic. Either the universe holds to a steady state, or it is exploding outward from a "big bang" that followed the super-concentration of some primordial cosmic dust. In either case, the universe is characterized by order, not entropy. In the case of the expanding universe (the prevailing hypothesis at present) there is more form and order in existence now than before the big bang. Once, the universe was perfectly entropic: an infinity of irreducibly primitive particles. Now it is not. Now it is morphically complex and hierarchically ordered, a universe of three-dimensional structures either in stable existence or moving in that direction through one-way processes in time. The universe not only *is* this way, but it continues to develop toward this end in obedience to evolutionary tendencies that are now envisaged by the various sciences to comprehend the inorganic as well as the organic.

Thus, biochemistry today assumes a pre-biotic, chemical evolution of the macromolecules, and astrophysics assumes an evolutionary life-cycle governing stars and galaxies. And even if stars, upon their "death," do become black holes (as some adventurous speculation currently suggests), that may not be the end of the morphic thrust. For there is even more daring speculation that the black holes "fall through" spacetime to come out the "other side" of the universe as *white* holes—which are, perhaps, the energy at the core of new galaxies or the true origin of quasars. In any case, at least up through the implosion of dwarf stars, the morphic tendency rules the behavior of matter. Quarks have assembled themselves into particles, particles into atoms, atoms into molecules. In turn, the molecules branch off along one line into planets, solar systems, galaxies, galactic clusters; and along their second line of development, they become intricate

cellular structures, which become coordinated, growing, reproductive organisms, and at last intelligent beings living in organized societies, enveloping themselves in highly ornate cultures.

This form- and structure-building process is as old as the universe and shows every sign of being supremely stable and infinitely ongoing. Where, in this big picture, is entropy, the enemy of form and order? The answer is: it is confined to tiny, contrived examples under analysis in the laboratories of scientists. Such "closed systems" are highly exceptional things in the universe. "Nature," Whyte observes, "does not seem to care much about them":

> The fact which we cannot . . . deny is that over vast regions of space and immense periods of time . . . the tendency toward disorder has not been powerful enough to arrest the formation of the great inorganic hierarchy and the myriad organic ones. The conditions of the universe and of this earth have been on the whole favorable to the morphic processes.

Whyte's vision has that compelling uniformity, simplicity and comprehensiveness which characterize all great scientific ideas. One feels, in its presence, that same sense of the suddenly discovered obvious which one finds in the work of Copernicus, Newton, Pasteur and Darwin. Yes, one finds oneself saying, why not accept the view that simplifies and integrates? What could be more apparent than that nature is a morphic and hierarchical whole?

For Whyte, this great truth was not simply a theory of nature. He saw it as the basis of "a world revolution, of a new religion, and of a scientific synthesis." It could be the vision that heals the human being's alienation from nature and cures the dissociation of our sensibilities. For the hierarchy of morphic processes Whyte saw in the universe at large is also at work in the human personality: in the natural coordination of the organism, in the spontaneous tendency of perception to seek Gestalt-like wholes, in the mind's search for intellectual and aesthetic order. The world view Whyte recommends to us vanquishes "Anti-man with his hopeless relativism" and replaces him with "Unitary Man . . . able to be more harmonious because he has become aware of the ordering processes at all levels in nature, without and within. In this new vision, man finds an absolute on which his thought can rest, for here at last subject and object are potentially fused in a single insight."

Whyte's world view is meant to be more than science, but it is nonetheless grounded in science. The audience to which he ultimately appeals is the scientific community, even though, in this work, he confines his more technical and theoretical arguments to extensive footnotes. Nothing he says is meant to be accepted as valid unless future fact and theory support it; Whyte never gave up hope that a mathematics of "global variables" would yet be invented to give his morphic vision a rigorous, experimental expression. As inspirational a document as this is, it is not intended to be a revelation but a guide and invitation to research. Its literary mode is that of Bacon's *Novum Organum*, Descartes' *Discourse on Method*, LaMettrie's *Man a Machine*, or Haeckel's *History of Creation.* It is a scientific manifesto intended to promote a general paradigm for future theory and experiment. And, like its predecessors in this odd genre, it promises not only fruitful research but world salvation.

How likely is Whyte's vision to receive in the foreseeable future the scientific validation he sought and predicted for it? I think not very. In this work, as in all his previous writing, he is asking more than professional science can give him—no less than a 180-degree turn of the scientific consciousness.

The problem is this: the prime fact on which Whyte builds his world view is the existence of various kinds of three-dimensional form and hierarchical structuring in nature. Now, the order he saw is really there; no scientist would dispute that. There are whole fields of science (such as stereochemistry or X-ray crystallography) which are now devoted to the study of three-dimensional natural structures. Whyte becomes controversial

when he contends that the structures are there because a special, as yet unexplicated morphic process has put them there, a process which he believed could be expressed as "the relaxation of extended spatial forms toward symmetry." Hidden in this idea is the conviction that the fundamental forces of nature are finalistic and holistic: immaterial tendencies that are out to shape matter into symmetries and hierarchies. But conventional science is dominated by a paradigm (and by a psychology) which insists that fundamental nature is random and atomistic. In its view, the "well-formed terminal states" Whyte studies can only be understood by analyzing quantitatively the behavior of their particularized components, which are ultimately governed by probabilities, and so by chance. Somehow, whatever looks like predestined form or orthogenic evolution must be portrayed as the accidental outcome of more primitive, radically aimless activities. Finding a way to do that is what scientists tell us a scientific explanation is all about.

Imagine two observers watching a table top covered with metal filings. Suddenly the filings begin to shift about and assume various regular shapes. The Conventional scientist perceives the shapes, but insists that their appearance is the fortuitous outcome of movement among several billion filings; the job of science, he would say, is to scrutinize the filings and to discover what forces or laws or probabilities account for their behavior. The reality of the phenomenon is the movement of the parts, not the shape of the whole. The other observer, following Whyte, would argue that such regularities could not be the haphazard result of random gyrations among the filings. There must be something else involved here, something like an invisible finger which sets out to draw these shapes and, in doing so, pushes the filings into such configurations. For this observer, the task of science is to understand the behavior of that finger. What are the forms it prefers to draw, and how does it achieve them?

The image of an invisible finger would perhaps be too anthropomorphic (or deistic) for Whyte's tastes, but his world view does come close to crediting nature with an intelligent patterning capacity—though a purely impersonal one. And that is a route science has, thus far, forsworn in the modern Western world, preferring a nature that is purposeless and mindless, where ordered complexity just happens to happen.

Similarly with the idea of hierarchy: for Whyte the cosmic hierarchy is prescriptive, indicating a direction in which nature prefers to move in obedience to its morphic tendency. But the only hierarchies conventional science recognizes are those based on quantitative differences between various orders: bigger or smaller, more or less complex. It prefers to use entropy as "time's arrow"; not because there is—or ever could be—any proof that the universe as a whole is entropic but because scientists are rarely concerned with the universe as a whole. Rather, they are concerned with specific, experimental situations, and the essence of experiment is contrivance and control. It is a matter of building a little, airtight box around what you study in order to isolate selected factors and secure precise measurements. In the nature of things, such little boxes are closed systems, and therefore what scientists want from thermodynamics are laws that will predict what happens in closed systems. What happens is entropy. Hence the second law, which serves experimental purposes admirably and so is confirmed over and over again by experimentation. Whyte's goal was to understand nature; most conventional scientists seek to understand experiments or, more properly, models of nature that can be embodied in experiments. That is the difference between natural philosophy and specialized research.

But there may be more to the matter. For scientists have generalized entropy to the universe at large, in spite of the fact that there are no cosmologies available which make any entropic sense. Why have they done such a zany thing?

Perhaps it is because entropy is nihilistic; it points toward universal death and dissolution, and so supports the assumption of an alien, humanly meaningless universe, a universe which is impassively, impersonally there for detached study and manipulation. This would be the universe that most effectively excludes all the hylozoistic assumptions of pre-modern natural philosophy. From this conveniently objective viewpoint, nothing could be more obnoxious than Whyte's idea of "valued qualitative states" and Aristotelean potentialities in nature. Such ideas cannot help but inhibit the smooth and rapid advance of research by intruding philosophy upon science and demanding wholeness of vision.

It is true enough that science has often changed its ground and dramatically shifted its paradigms against powerful professional resistance. Not much more than a generation ago, Wegener's theory of continental drift was widely regarded by geophysical authorities as a crackpot notion; in the 1930s it was even "proved" to be mathematically impossible. Now, in the form of plate tectonics, it has become the new orthodoxy of the earth sciences. There are many such examples in the various sciences. But what Whyte requires is not simply a change of paradigms in one field of science but the transformation of the fundamental sensibility of science as a whole. To proceed analytically from the whole to the parts, to reduce qualities to quantities, to exclude final causes, to assume the radical objectivity of nature: these are not so many hypotheses up for proof. All this, taken together, *is* science—or at least science as we have known it in the West since the days of Galileo.

For my own, thoroughly unscientific part, I find Whyte's morphological universe to be wise, true and beautiful. It makes more elegant sense of what science has discovered about nature than any rival theory of comparable comprehensiveness. When microbiologists speak of a "recognition system" among the organic molecules, I think they call it "recognition" because they indeed see there a primitive, form-oriented intelligence which adumbrates the human mind. So that is how they too make sense of what they observe. But, of course, they cannot admit that, even though they know it is so. Professional discipline prevents them from suggesting any human meaning in nature which is not a counsel of despair. But the meaning is there nonetheless, and our science would be a poor thing indeed if there were not insurgent types like Lancelot Whyte around its edges who are brave enough to commit the professional indiscretion of saying so.

THEODORE ROSZAK

REVIEW
DITHYRAMBLE

IT is natural, from time to time, for a reviewer to be overtaken by fits of conscience. Many of the books he gives attention to contain *too much* for any reader to cope with. When you think about books you have read, you realize that only a small fraction of the contents can be remembered. The amount added to one's intellectual working capital from reading a book is usually slight, while, on the other hand, a single sentence or paragraph, happened on by accident, may become the nucleus for thinking that extends in many directions.

One apparently "too much" book noticed in MANAS something over a year ago—which never got put on the shelf because it's so pleasant to look at—is Lloyd Kahn's *Shelter,* containing nearly two hundred very large pages of excellent illustrations (photographs and drawings) of the structures (ancient and modern) that people all over the world have put up to live in, store food in, and meet with one another in. The book is an embarrassment of riches. Who gets the most out of such a book? Obviously, the author. Lloyd Kahn will never be the same after putting together that book. His mind will be forever after a wonderfully organized encyclopedia of diversity in the arts of building and home-making. He will be a walking Smithsonian Institution of the world's dwellings. What's wrong with that? Nothing, of course. And people who want to apply what they learn or know can look at *Shelter* simply as a resource—which it is—and not as a manual for action. It remains visually exciting, no matter what you call it.

Yet *Shelter* nonetheless reminds one of what Stewart Edward White said in one of his books about the West—that Nature, in the Yosemite Valley, concentrated in a few acres what ought to have been spread out over seventy miles!

Perhaps this view misconceives the role of extremes. "Nothing in excess" might be a counsel that would have no meaning without plenty of examples of both excess and hardly anything at all, spread out before us in the natural world. The balances, or the possibilities of balance, are in ourselves. So, regarding Mr. Kahn as a natural phenomenon—which, in his way, he is—we should feel only gratitude for what he has done. His vast museum of home-building ingenuities is a Yosemite Valley of human accomplishment.

But we still ought to remember what André Malraux said about museums in *The Voices of Silence:*

> The practice of pitting works of art against each other, an intellectual activity, is at the opposite pole from the mood of relaxation which alone makes contemplation possible. To the Asiatic's thinking an art collection (except for educational purposes) is as preposterous as would be a concert in which one listened to a programme of ill-assorted pieces following in unbroken succession.

Well, the structures in Lloyd Kahn's *Shelter* are not fine-art splendors, nor are they "ill-assorted," and you could say that they are all in one book "for educational purposes."

There is, however, another critical view that applies to the educational encyclopedias made possible by modern technology. In *Art and Technics,* Lewis Mumford wrote of the automatic surfeit that results from exposure to a multiplicity of excellences in any field. "There are certain occasions in life," he says, "when the aristocratic principle must balance the democratic one, when the personalism of art, fully entered into, must counteract the imperialism, and therefore the superficiality, of technics." Mr. Kahn, of course, is not celebrating technics, but the ingenuities, utility, and fitness of craft. However, Mumford also says: "The rarity of the experience is an essential preparation for the delight. Without rhythm and interval there is only satiation and ennui."

Mr. Mumford adds this generalization:

> As a result of this whole mechanical process, we cease to live in a multi-dimensional world of reality, the world that brings into play every aspect of the human personality, from its bony structure to its

> tenderest emotions: we have substituted for this, largely through the mass production of graphic symbols—abetted by a similar multiplication and reproduction of sounds—a secondhand world, a ghost world, in which everyone lives a secondhand and derivative life.

Well, we are all guilty—we can't help being guilty, some of the time—since that is the sort of world we have made into a condition of life. Mumford asks:

> What is responsible for this perversion of the whole process of reproduction? Something we should have been aware of from the beginning. We have gratuitously assumed that the mere existence of a mechanism for manifolding or mass production carries with it an obligation to use it to the fullest capacity. *But there is simply no such necessity. Once you discover this, you are a free man.*

So, then, you blaze your own trail through the tropical technological jungle of goodies. You don't have to expose yourself to the point of satiety, hang around in "this kingdom of shadows" that Mumford regards as "the ultimate destination of our mechanistic and mammonistic culture." Actually, Mr. Kahn uses the tools and skills of this culture to oppose its mechanistic tendencies. But the reader has responsibilities, too. One ought not to regard *Shelter* as a coffee table attraction. It wasn't meant to be that. If encyclopedias have a value, then an encyclopedia of intermediate technology in home construction is surely a good thing.

Mumford calls the one who chooses his own way, ignoring common and customary compulsions, "a free man." What makes a man free? This, we submit, comes very close to being a complete mystery. We can locate examples but give little explanation of them. We think of two now living men who freely ordered their lives by reason of a profound sense of meaning which became the canon of decision—*their* decision, as contrasted with the pressures and luxuries of the environment. The sense of meaning or purpose was born in each of these men in moments of solitude.

In *Finding His World* (compiled by Mrs. Morgan), Arthur Morgan repeats from his diary his reflections at twenty-one:

> It is the possibility of there being no foundation for my faith in things and of my then being a dreamer; it is this possibility I want removed. The possibility at times seems small, but at other times seems to become equal to the other. That is, it sometimes seems equally possible that the universe is purposeful and that it is purposeless.
>
> For about three years I have lived on the supposition that there is a divine purpose, and it seems to me that is the only way to live. If we don't live consciously on that supposition, we live unconsciously on it, because the laws of the universe seem to govern us whether we will or no. It is only a choice of acting willingly or by compulsion. To bemoan the thought of the possibility of the universe being purposeless would demand an infinite intelligence.

Here was a man making up his mind; having done this, independent decisions became less difficult. But why did Morgan consult himself so intensively at twenty-one? If we want to understand what Mumford terms "freedom," we need to wonder about this.

Early in life William O. Douglas was stricken by polio, and while he was afterwards able to walk, his legs were like reeds and he hated the weakness that barred him from so many natural pleasures. In his early teens he started hiking in the mountains near Yakima, Washington, where he lived, to strengthen his legs. One moon-filled night, camping on a barren ridge, he felt the warm chinook wind on his cheeks:

> It became for me that night a measure of the kindliness of the universe to man, a token of the hospitality that awaits man when he puts foot on this earth. It became for me a promise of the fullness of life to him who, instead of shaking his fist at the sky, looks to it for health and strength and courage.
>
> That night I felt at peace. I felt that I was a part of the universe, a companion to the friendly chinook that brought the promise of life and adventure. That night, I think, there first came to me the germ of a philosophy of life: that man's best measure of the universe is in his hopes and his dreams not his fears,

> that man is part of a plan, only a fraction of which he, perhaps, can ever comprehend.

This is quoted from *Go East, Young Man*, Justice Douglas' autobiography published last year by Random House.

What did Mumford mean by freedom and how does it apply here? Well, both Morgan and Douglas became remarkably independent in their decisions of what to do with their lives, how to live them, what to concentrate on and what to pay little or no attention to—except for things which badly need to be changed. Such individuals, you could say, put their own rules in the place of the world's, showing that this works better than the world's way does. They manage, but not without difficulty, to get along in the world. They conduct their lives and their projects by principles which sometimes seem far beyond the world's understanding. The cause of their unusual distinction remains obscure, although from biography we obtain some clues to why they lived their lives as they did, and why they adopted their own standards, instead of the world's.

They are sometimes willing to discuss their opinions and decisions with others, and for this reason they make especially good reading.

COMMENTARY
THE NEW BEGINNING

WHILE Theodore Roszak speaks of himself (see page 7) as "thoroughly unscientific," it seems just to point out that he is rather the defender and champion of the true spirit of science, and may be regarded as a distinguished philosopher of science in our time. He is the critic, not of the searching impartiality of scientific intelligence, but of the narrow defense-mechanisms which were adopted as long ago as the eighteenth century (and even before) by scientific thinkers who felt compelled by religious bigotry and theological arrogance to use any weapons they could find in their struggle against thought-control. As Bertrand Russell put it in his introduction to Lange's *History of Materialism,* "As a rule, the materialistic dogma has not been set up by men who loved dogma, but by men who felt that nothing less definite would enable them to fight the dogmas they disliked." In short, the materialistic dogma, chosen opportunistically by such embattled thinkers as LaMettrie and d'Holbach in France, and by Locke and Hume in England, was institutionalized by the rank and file of lesser scientific thinkers, and made into a methodological absolute. Thereafter, agnosticism became the approved form of scientific piety, while the denial of any sort of inherent meaning in natural occurrences became primary "truth" for the zealots and propagandists of *sci*entffic progress.

In this review of Lancelot L. Whyte's last book, Mr. Roszak undertakes the restoration to science of its original spirit of Natural Philosophy. What is Whyte's—and Roszak's essential point? It is not new, it is not obscure, and it is hardly deniable. It is the argument from Design. Why, since the argument from design was first proposed, has it been so consistently ignored by the great majority of scientific thinkers? It was ignored by reason of its expected consequences—the consequences sought, in fact, by most of those who made this argument—human acceptance and belief in a "God" who takes part, who "interferes," and who variously plays havoc in the affairs of men determined to work out their own salvation, arrive at their own conceptions of truth, and remain free of the arbitrary authority of "God's" self-appointed spokesmen. There is really no other important explanation of the insistent materialism of scientists and many other thoughtful human beings. Under extreme historical pressures, they felt it necessary to ignore the manifest common sense in the argument from design.

Today the historical pressures are in the opposite direction. We suffer, now, more from the denials of meaning than from the tyrannies of unsupported belief. So it is natural for men who try to extricate their thought from historical conditionings to look for sources of a sense of meaning in areas that have been systematically neglected. Whyte revived the argument from design, but without its morally and intellectually objectionable feature—the idea of "God." The consequence of the argument for design, in Whyte's presentation, is simply acknowledgement of the presence of form-creating tendencies or forces everywhere in the universe, observable in hierarchical orders of intelligence—"purely impersonal," as Roszak says.

So regarded, Whyte's outlook may be recognized as acceptance of the obvious. Not only the universal testimony of the objective world supports it, but all the evidence of subjective experience—the movement and capacity of our minds, the mandate of our feelings—supports this view. Against it stands no more than the institutionalized habits born from an eighteenth-century polemic. Actually, the thrust of the best thought of the time is now in the direction indicated by such writers as L. L. Whyte. Involved is a fundamental movement of the human spirit, an awakening or recovery which gives voice to the flooding realization that moral and imaginative capacities are the defining characteristics of human beings.

For several centuries men have persuaded themselves that reality is to be known only through mastery of the forces of external nature. This idea of reality shuts out from consideration the essential nature of man, and a point has been reached where the breakdowns and dislocations it produces in our lives are no longer tolerable.

The need for change, therefore, is evident. Yet the sort of change we need and hunger for is difficult. To move from the definable and objective to dependence on the incommensurable and subjective is likely to seem a leap into the unknown. And so it is, from one point of view. But another perspective discloses that the human beings who have lived the most ordered and useful lives, and who most consistently devoted themselves to the service of others, guided themselves by this sense of reality. Apparently at least some of the unknown, or a sufficiency of it, can be known.

CHILDREN
. . . and Ourselves
ECOLOGY ASSESSMENT

THERE is much talk, today, about "technology assessment," as a means of guarding against future misuse and for control of existing technology. Congressman George Brown (Calif.) recently sponsored legislation leading to the establishment of a Technology Assessment Commission charged with such responsibilities—which are admittedly extensive and difficult to carry out. Conceivably, far more could be accomplished by such a body with the support of enlightened public opinion—of more people individually aware of the need for regulation of the applications of technology, which are increasing, for better or for worse, all the time.

One place—perhaps the best place—to start with the creation of enlightened public opinion is in the schools. Frontiers for March 26 described the "Urban Physics Course" taught for five years by Edwin H. Marston at Ramapo College—education which shows in specific terms how technology changes living conditions, often degrading them, and illustrates the limitations of "technological fixes." Students who know something of the physics of urban water supply and transportation have at least a foundation for informed opinion in relation to technology assessment and control.

This education ought to begin with what we already know—or could easily know—but don't apply. Take the Southwest of the United States, for example. The entire region has been variously abused by land policies, water policies, and rapacious technological development. But if legislators of a century ago—prodded and backed by informed public opinion—had given careful attention to John Wesley Powell's *Report on the Lands of the Arid Region of the United States* (1878), the story would now be vastly different. Among other things, Powell said that settlers in these areas would have to learn to work *with* nature, the way the Spanish colonizers and the Mormons had done. Hardly anyone listened to him. So, a good beginning would be to go back to Powell. There would be bonuses in this. Powell is a romantic figure—the man who, with only one arm (the other lost at Shiloh in the Civil War) led the expedition which first ran the rapids of the Colorado River, to gather scientific information and map the region. Next, one might turn to a modern case study of an arid region, Peter Van Dresser's *A Landscape for Humans,* which is precisely what Powell called for—a plan for development of the arid uplands of New Mexico based on working *with* nature, starting with the practice once established in the region by the original colonists who knew what to do from experience in the mountainous areas of their Spanish homeland. (Van Dresser's book is available at $3.00 from Biotechnic Press, P.O. Box 26091, Albuquerque, N.M. 87125.)

All this is not, of course, technology assessment, but human ecology assessment (with some agricultural technology included). However, the study of the natural environment and of existing human relations with it may be the best kind of assessment to start with, since it is usually more accessible, both physically and psychologically, to people going to school in the West. And it may be logical to obtain a working understanding of ecological complexity before attempting the study of technological complexity, which often seems almost impenetrable!

An example of ecological complexity is provided by Cyrus McKell in a paper in *Science* for March 7, "Shrubs—A Neglected Resource of Arid Lands." The writer is professor of range science and director of the Environment and Man Program, Utah University. Two things are at once evident from what Prof. McKell says: First, there is a great deal of ignorance about desert shrubs; second, there is a great deal of ignoring of what is already known about desert shrubs. We are continually subjected, these days, to the cry for "more research" to find out things we don't know. But it seems ridiculous to insist on more research when we so seldom apply what we do know. Our problem is not knowledge, but the inclination to use it. The whole idea of "research" would probably be transformed if we began applying intelligently what is already known.

It is not facts that we need, but knowledge of the function of the facts in life; not "science," but a grasp of the vital part played by understanding in human welfare and well-being; not the abstract truth but its application for the common good—these are the considerations that play the crucial role in education. A good curriculum is not a choice selection of courses but an exposure to activities which have some hope of generating a field hospitable to *caring* about knowing, and to the will to know. The students, being human, can be expected to do the rest.

Well, how might a particular project having to do with shrubs that grow on arid Southwestern lands get going? One we have learned about, while not especially adaptable to education in the field, seems intensely interesting and of obvious importance. During World War II, Robert A. Millikan, the eminent physicist who then headed Caltech, recognized that when Malaya fell to the Japanese rubber would soon be in short supply in America. He also knew that the desert shrub, guayule, is a prime source of rubber. Realizing that dozens of talented Nisei, some of them scientists, had been foolishly and unjustly sent to internment camps for the duration, he suggested that the botanists among them be invited to devote themselves to the cultivation of guayule as a new source of rubber. He interested a Caltech plant physiologist, Robert Emerson, and Emerson enlisted the help of friends to go up to Salinas (Calif.), where the Federal headquarters for growing guayule was located, to collect some toppings and take them to Manzanar, where the Nisei scientists and gardeners were eager to get to work. No one, of course, according to textbook knowledge, could grow guayule from cuttings, but the Manzanar botanists did it. With the help of various people a complete program for rubber production from guayule was worked out at Manzanar. A new extraction technique was developed which produced 100 per cent pure raw rubber. By this method it was possible to leave the desired amount of natural resins in the rubber for use in products requiring soft rubber, while the pure stock was ideal for hard rubber items. Guayule has numerous advantages over tree rubber, not the least of which is that this plant thrives under desert conditions, and can be brought (by controlled irrigation) to harvest almost at will. It is much less costly to grow than tree rubber, and, finally, could convert into productive use vast areas of supposedly marginal land.

All this work was done, but nothing happened. That is, no use has been made of this rather extraordinary development of a desert plant. Instead, in the early 1940s the Los Angeles area began to be smothered by smog as a result of the synthetic rubber plants hastily put into operation to replace the no longer available tree rubber; meanwhile the West Coast Government guayule plantings (totalling 32,000 acres) were all harvested at the insistence of the Trumbull Committee because the U.S. rubber inventory had reached an all-time low and artificial rubber was in those days of very poor quality. Although a private group continued experiment and development on a plantation near Beaumont, California, growing and extracting fine rubber, they were unable to market it, since permission to harvest a "strategic war material" was denied. By that time the oil companies (synthetic rubber is made from a portion of the ingredients of petroleum) were definitely not interested in seeing fine natural rubber come on the market, least of all better rubber that, by the methods that had been developed, could be produced at a fraction of the cost of either tree or artificial rubber, with greater efficiencies and savings every step of the way.

Millikan's dream died aborning. This could not have happened to a country whose people knew something of desert ecology and had acquired an understanding of what it means to "design with nature," as Prof. McKell (and Ian McHarg) have proposed. A final happy thought for the times: guayule plantings emit sixteen tons of oxygen per acre per year.