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It is my proposition that, to all practical purposes, western man remains obdurately pre-Copernican, believing that he bestrides the earth round which the sun, the galaxy, and the very cosmos revolve. This delusion has fueled our ignorance in time past and is directly responsible for the prodigal destruction of nature and for the encapsulating burrows that are the dysgenic city.

We must see nature and man as an evolutionary process which responds to laws, which exhibits direction, and which is subject to the final test of survival. We must learn that nature includes an intrinsic value-system in which the currency is energy and the inventory is matter and its cycles—the oceans and the hydrologic cycle, life-forms and their roles, the cooperative mechanisms which life has developed and, not least, their genetic potential. The measure of success in this process, in terms of the biosphere, is the accumulation of negentropy in physical systems and ecosystems, the evolution of apperception or consciousness, and the extension of symbioses—all of which might well be described as creation.

This can be pictured simply in a comparison between the early earth and the present planet. In the intervening billions of years the earth has been transformed and the major change has been in the increase of order. Think of the turbulence and violence of the early earth, racked by earthquakes and vulcanism, as it evolved toward equilibrium, and of the unrestrained movements of water, the dust storms of unstabilized soils, and the extreme alternations of climate unmodified by a green, meliorative vegetative cover. In this early world physical processes operated toward repose, but in the shallow bays there emerged life and a new kind of ordering was initiated. The atmosphere which could sustain life was not the least of the creations of life. Life elaborated in the seas and then colonized the earth, thus increasing the opportunities for life and for evolution. Plants and decomposers created the soils, anchored the surface of the earth, checked the movements of soil particles, modified water processes, meliorated the climate, and ordered the distribution of nutrients. Species evolved to occupy and create more habitats, more niches, each in-

crease requiring new cooperative relationships between organisms—new roles, all of which were beneficial. In the earth's history can be seen the orderings which life has accomplished: the increase to life forms, habitats and roles, symbiotic relationships, and the dynamic equilibrium in the system—the total an increase in order. This is creation.

In the early earth, the sunlight which fell upon the planet equaled the degraded energy which was radiated from it. Since the beginning of plantlife, some of the sun's energy has been entrapped by photosynthesis and employed with matter to constitute the ordered beings of plants; thence, to the animals and decomposers, and all of the orderings which they have accomplished. This energy will surely be degraded, but the entrapped energy, with matter, is manifest in all life forms past and present, and in all of the orderings which they have accomplished. Thus, creation equals the energy which has been temporarily entrapped and used with matter to accomplish all of the ordering of physical, biological, and cultural evolution. This physicists describe as negentropy, in contrast with the inevitable degradation of energy which is described as entropy.

By this we see the world as a creative process involving all matter and all life forms in all time past and in the present. Thus, creation reveals two forms: first, the physical entrapment and ordering which is accomplished primarily by plants and by the simplest animals; and second, apperception and the resulting ordering for which an increased capacity is observed as species rise in the phylogenetic scale. In this, man is seen to be especially endowed. This view of the world as a creative process involving all of its denizens, including man, in a cooperative enterprise, is foreign to the western tradition that insists upon the exclusive divinity of man, his independent superiority, dominion, and license to subjugate the earth. It is this man in whose image was God made. This concept of nature as a creative, interacting process in which man is involved with all other life forms is the ecological view. It is, I submit, the best approximation of the world that has been presented to us, and the indispensable approach to determining the role of man in the biosphere. It is indispensable also

for investigation, not only of the adaptations which man accomplishes, but of their forms.

The place, the plants, the animals, and man, and the orderings which they have accomplished over time, are revealed in form. To understand this, it is necessary to invoke all physical, biological, and cultural evolution. Form and process are indivisible aspects of a single phenomenon: being. Norbert Weiner described the world as consisting of « To Whom It May Concern » messages, but these are clothed in form. Process and fitness (which is the criterion of process) are revealed in form; form contains meaning. The artifact, tool, room, street, building, town or city, garden or region, can be examined in terms of process, manifest in form, which may be unfit, fit, or most fitting. The last of these, when made by man, is art.

The role of man is to understand nature, which is also to say man, and to intervene to enhance its creative processes. He is the prospective steward of the biosphere. The fruits of the anthropocentric view are in the improvement of the social environment, and great indeed are their values, but an encomium on social evolution is not my competence, and I leave the subject with the observation that, while Madison, Jefferson, Hamilton, and Washington might well take pride in many of our institutions, it is likely that they would recoil in horror from the face of the land of the free.

An indictment of the physical environment is too easy, for post-industrial cities are such squalid testimony to the bondage of toil and to the insensitivity of man, that the most casual examination of history reveals the modern city as a travesty of its antecedents and a denial of its role as the proudest testimony to peoples and their cultures. The city is no longer the preferred residence for the polite, the civilized, and the urbane, all of which say « city ». They have fled to the illusion of the suburb, escaping the iridescent shills, neon vulgarity of the merchants, usurious slumlords, cynical polluters (household names for great corporations, not yet housebroken), crime, violence and corruption. Thus, the city is the home of the poor, who are chained to it, and the repository of dirty industry and the commuter's automobile. Give us your poor and oppressed, and we will give them Harlem and the Lower East Side, Bedford-Stuyvesant, the South Side of Chicago, and the North of Philadelphia—or, if they are very lucky, Levittown. Look at one of these habitats through the Cornell Medical School study of Midtown Manhattan, where 20 per cent of a sample population was found to be indistinguishable from the patients in mental institutions, and where a further 60 per cent evidenced mental disease. Observe the environments of physical, mental, and social pathology. What of the countryside? Well, you may drive from the city and search for the rural landscape, but to do so you will follow the paths of those who preceded you, and many of

them stayed to build. But those who did so *first* are now deeply embedded in the fabric of the city. So as you go you will transect the annular rings of the thwarted and disillusioned who are encapsulated in the city as nature endlessly eludes pursuit. You can tell when you have reached the edge of the rural scene for there are many emblems: the cadavers of old trees, piled in untidy heaps beside the magnificent machines for land despoliation, at the edge of the razed deserts; forests felled; marshes filled; farms obliterated; streams culverted; and the sweet rural scene transformed into the tacky-tacky vulgarity of the merchants' creed and expression. What of the continent? Well, Lake Erie is on the verge of becoming septic, New York suffers from water shortages as the Hudson flows foully past, and the Delaware is threatened by salt water intrusion. Smog, forest fires, and mud slides have become a way of life for Los Angeles. In San Francisco, the Bay is being filled and men build upon unconsolidated sediments, the most perilous foundations in this earthquake-prone area. DDT is in arctic ice and ocean deeps, radioactive wastes rest on the Continental Shelf, the Mississippi is engorged with five cubic miles of topsoil each year, the primeval forests are all but gone, flood and drought become increasingly common, the once-deep prairie soils are thinner now and we might as well recognize that itinerant investment farming is just another extractive industry.

This is the face of our western inheritance—Judaism, Christianity, Humanism, and the Materialism which is better named Economic Determinism. The countryside, the last great cornucopia of the world's bounty, ravaged; and the city of man (God's Junkyard, or call it Bedlam) a vast demonstration of man's inhumanity to man, where existence, sustained by modern medicine and social legislation, is possible in spite of the physical environment. Yet we are the inheritors of enormous beauty, wealth, and variety. Our world is aching for the glorious cities of civilized and urbane men. Land and resources are abundant. We could build a thousand new cities in the most wonderful locations—on mountains and plains, on rocky ocean promontories, on desert and delta, by rivers and lakes, on islands and plateaus. It is within our compass to select the widest range of the most desirable lands and promulgate policies and regulations to ensure the realization of these cities, each in response to the nature of its site. We can manage the land for its health, productivity and beauty. All of these things are within the capacity of this people now. It is necessary to resolve to fulfill the American Revolution and to create the fair image that can be the land of the free and the home of the brave. But to resolve is not enough; it is also necessary that society at large understand nature as a process, having values, limiting factors, opportunities, and constraints; that creation and destruction are real; that there are criteria by which we can dis-

cern the direction and tests of evolution; and, finally, that there are formal implications revealed in the environment which affect the nature and form of human adaptations.

What inherited values have produced this plight, from which we must be released if the revolution is to be completed? Surely it is the very core of our tradition, the Judeo-Christian-Humanist view which is so unknowing of nature and of man, which has bred and sustained his simple-minded anthropocentrism and anthropomorphism. It is this obsolete view of man and nature which is the greatest impediment to our emancipation as managers of the countryside, city builders, and artists. If it requires little effort to mobilize a sweeping indictment of the physical environment which is man's creation, it takes little more to identify the source of the value system which is the culprit. Whatever the origins, the text is quite clear in Judaism, was absorbed all but unchanged into Christianity, and was inflated in Humanism to become the implicit attitude of western man to nature and the environment. Man is exclusively divine, all other creatures and things occupy lower and generally inconsequential status; man is given dominion over all creatures and things; he is enjoined to subdue the earth. Here is the best of all possible texts for him who would contemplate biocide, carelessly extirpate great realms of life, create Panama Canals, or dig Alaskan harbors with atomic demolition. Here is the appropriate in junction for the land rapist, the befouler of air and water, the uglifier, and the gratified bulldozer. Dominion and subjugation, or better call it conquest, are their creeds. It matters little that theologians point to the same source for a different text, and choose rather the image of man the steward who should dress the garden and keep it. It matters little that Buber and Heschel, Teilhard de Chardin, Weigel and Tillich retreat from the literality of the dominion and subjugation text, and insist that this is allegory. It remains the literal injunction which has been so warmly welcomed and enshired at the core of the western view. This environment was created by the man who believes that the cosmos is a pyramid erected to support man on its pinnacle, that reality exists only because man can perceive it, that God is made in the image of man, and that the world consists solely of a dialog between men. Surely this is an infantilism which is unendurable. It is a residue from a past of inconsequence when a few puny men cried of their supremacy to an unhearing and uncaring world. One longs for a psychiatrist who can assure man that his deep seated cultural inferiority is no longer necessary or appropriate. He can now stand erect among the creatures and reveal his emancipation. His ancient vengeance and strident cries are a product of an earlier insignificance and are now obsolete. It is not really necessary to destroy nature in order to obtain God's favor or even his undivided attention. To this ancient view the past two centuries have added

only materialism—an economic determinism which has merely sustained earlier views.

The face of the city and the land are the best testimony to the concept of conquest and exploitation—the merchant's creed. The Gross National Product is the proof of its success, money is its measure, convenience is its cohort, the short term is its span, and the devil take the hindmost is its morality. The economists, with some conspicuous exceptions, have become the spokesmen for the merchants' creed and in concert they ask with the most barefaced affrontery that we accommodate our values to theirs. Neither love nor compassion, health nor beauty, dignity nor freedom, grace nor delight are true unless they can be priced. If not, they are described as nonprice benefits and relegated to inconsequence, and the economic model proceeds towards its self-fulfillment—which is to say more despoliation. The major criticism of this model is not that it is partial (which is conceded by its strongest advocates), but more that the features which are excluded are among the most important human values, and also the requirements for survival. If the ethics of society insist that it is man's bounden duty to subdue the earth, then it is likely that he will obtain the tools with which to accomplish this. If there is established a value system based upon exploitation of the earth, then the essential components for survival, health, and evolution are likely to be discounted, as they are. It can then come as no surprise to us that the most scabrous slum is more highly valued than the most beautiful landscape, that the most loathsome roadside stand is more highly valued than the richest farmland, and that this society should more highly prize tomato stakes than the primeval redwoods whence they come.

It is, in part, understandable why our economic value system is completely blind to the realities of the biophysical world—why it excludes from consideration, not only the most important human aspirations, but even those processes which are indispensable for survival. The origins of society and exchange began in an early world where man was a trifling inconsequence in the face of an overwhelming nature. He knew little of its operation. He bartered his surpluses of food and hides, cattle, sheep and goats; and valued such scarcities as gold, silver, myrrh and frankincense. In the intervening millennia the valuations attributed to commodities have increased in range and precision and the understanding of the operation of this limited sphere has increased dramatically. Yet, we are still unable to identify and evaluate the processes which are indispensable for survival. When you give money to a broker to invest you do so on the understanding that this man understands a process well enough to make the investment a productive one. Who are the men to whom you entrust the responsibility for ensuring a productive return on the world's investment? Surely, those who understand physical and bio-

logical processes, realize that these are creative. The man who views plants as the basis of negentropy in the world and the base of the food chain, as the source of atmospheric oxygen, fossil fuels and fibers, is a different man from one who values only economic plants, or that man who considers them as decorative but irrelevant aspects of life. The man who sees the sun as the source of life and the hydrologic cycle as its greatest work, is a different man from one who values sunlight in terms of a recreation industry, a portion of agricultural income, or from that man who can obscure sky and sunlight with air pollution, or who carelessly befools water. The man who knows that the great recycling of matter, the return stroke in the world's cycles, is performed by the decomposer bacteria, views soils and water differently from the man who values a few bacteria in antibiotics, or the who is so unknowing of bacteria that he can blithely sterilize soils or make streams septic. That man who has no sense of the time which it has taken for the elaboration of life and symbiotic arrangements which have evolved, can carelessly extirpate creatures. That man who knows nothing of the value of the genetic pool, the greatest resource which we bring to the future, is not likely to fear radiation hazard or to value life. Clearly, it is illusory to expect the formulation of a precise value system which can include the relative value of sun, moon, stars, the changing seasons, physical processes, life forms, their roles, their symbiotic relationships, or the genetic pool. Yet, without precise evaluation, it is apparent that there will be a profound difference in attitude—indeed, a profoundly different value system—between those who understand the history of evolution and the interacting processes of the biosphere, and those who do not.

The simpler people who were our ancestors (like primitive peoples today) did not subscribe to anthropocentric views, nor did the 18th-century English landscape tradition which is the finest accomplishment of western art in the environment, and which derives from a different hypothesis. The vernacular architecture in the western tradition and the attitudes of the good farmer come from yet another source, one which has more consonance with the Orient than the West. But the views which ensured successes for the hunter and gatherer, for the vernacular farmer, and for the creation of a rich and beautiful pastoral landscape are inadequate to deal with 20th-century problems of an inordinate population growth, accelerating technology and transformation from a rural to an urban world. We need a general theory which encompasses physical, biological, and cultural evolution; which contains an intrinsic value system; which includes criteria of creativity and destruction and, not least, principles by which we can measure adaptations and their form. Surely, the minimum requirement for an attitude to nature and to man is that it approximate reality. Clearly, our traditional view does not.



If one would know of these things, where else should one turn but to science. If one wishes to know of the phenomenal world, where better to ask than the natural sciences; if you would know of the interactions between organism and environment, then turn to the ecologist, for this is his competence. From the ecological view, one can conclude that by living one is united physically to the origins of life. If life originated from matter then by living one is united with the primeval hydrogen. The earth has been the one home for all of its evolving processes and for all of its inhabitants; from hydrogen to man, it is only the bathing sunlight which changes. The planet contains our origins, our history, our milieu—it is our home. It is in this sense that ecology, derived oikos, is the science of the home. Can we review physical and biological evolution to discern the character of these processes, their direction, the laws which obtain, the criteria for survival and success? If this can be done, there will also be revealed an intrinsic value system and the basis for form. This is the essential ingredient of an adequate view of the world: a value system which corresponds to the creative processes of the world, and both a diagnostic and constructive view of human adaptations and their form.

The evolution of the world reveals movement from more to less random, from less to more structured, from simplicity to diversity, from few to many life forms—in a word, toward greater negentropy. This can be seen in the evolution of the elements, the compounds, and of life. It is accomplished by physical processes, as in the early earth when matter liquefied and coalesced, forming the concentric cores of the planet. Vulcanism revealed the turbulence of early adaptations toward equilibrium. So, too, did the creation of the oceans. Evaporation and precipitation initiated the processes of erosion and sedimentation in which matter was physically sorted and ordered. When, from the aluminosilicate clays in the shallow bays, there emerged that novel organization, life, there developed a new agency for accomplishing ordering. The chloroplast of the plant was enabled to transmute sunlight into a higher ordering, sustaining all life. The atmosphere, originally hostile to life, was adapted by life to sustain and protect it, another form of ordering. The emergence of the decomposers, bacteria and fungi, permitted the wastes of life forms—and their substance after death—to be recycled and utilized by the living, the return stroke in the cycle of matter in the biosphere. The increasing number of organisms in the oceans and on land represent negentropy in their being and in the ordering which they accomplish. We can now see the earth as a process by which the falling sunlight is destined for entropy, but is arrested and entrapped by physical processes and creatures, and reconstituted into higher and higher levels of order as evolution proceeds. Entropy is the low and demands its price, but while all

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L'équilibre écologique d'il y a 55 millions d'années.

energy is destined to become degraded, physical and biological systems move to higher order—from instability towards steady-state—in sum, to more negentropy. Evolution is thus a creative process in which all physical processes and life forms participate. Creation involves the raising of matter and energy from lower to higher levels of order. Retrogression and destruction consist of reduction from the higher levels or order to entropy.

As life can only be transmitted by life, then the spore, seed, egg, and sperm contain a record of the entire history of life. The journey was shared with the worms, the coelenterates, the sponges, and, later, with the cartilaginous and bony fishes. The reptilian line is ours, the common ancestor that we share with the birds. We left this path to assume mammalian form, live births, the placenta, and suckling of the young; the long period of infantile dependence marks us. From this branching line the monotremes, marsupials, edentates, and pangolins followed their paths, and we proceeded on the primate way. Tree shrew, lemur, tarsier and anthropoid, are our lineage. We are the line of man—the raised ape, the enlarged brain, the toolmaker—he of speech and symbols, conscious of the world and of himself. It is all written on the sperm and on the egg although the brain knows little of this journey. We have been through these stages in time past and the imprint of the journey is upon us. We can look at the world and see our kin; for we are united, by living, with all life, and are from the same origins. Life has proceeded from simple to complex, although the simplest forms have not been superseded, only augmented. It has proceeded from uniform to diverse, from few to many species. Life has revealed evolution as a progression from greater to lesser entropy. In the beginning was the atom of hydrogen with one electron. Matter evolved in the cosmic cauldrons, adding electron after electron, and terminating in the heaviest and most ephemeral of elements. Simple elements conjoined as compounds, thus reaching the most complex of these as amino acids, which is to say life. Life reached unicellular form and proceeded through tissue and organ to complex organisms. There were few species in the beginning and now they are myriad; there were few roles and now they are legion. There were once large populations of few species; now there is a biosphere consisting of multitudes of communities composed of innumerable interacting species. Evolution has revealed a progression from simple to complex, from uniform to diverse, from unicellular to multicelled, from few to many species, from few to many ecosystems, and the relations between these processes have also evolved toward increased complexity.

What holds the electrons to the nucleus? The molecules in rocks, air, and water may have ten atoms, but the organic molecule may have a thousand. Where is the catalytic enzyme which

locks and unlocks the molecules? The single cell is very complex indeed; what orchestrates the cytoplasm and nucleus, nucleolus, mitochondria, chromosomes, centrosomes, Golgi elements, plastids, chromoplasts, leucoplasts and, not least, chloroplasts? The lichen shows an early symbiosis at the level of the organism as the alga and the fungus unite. The plant and the decomposer enter into symbiosis to utilize energy and matter, to employ the first and recycle the latter. The animal enters the cycle, consuming the plant, to be consumed by the decomposer and thence by the plant. Each creature must adapt to the others in that concession of autonomy toward the end of survival that is symbiosis. Thus parasite and host, predator and prey, and those creatures of mutual benefit develop symbioses to ensure survival. The world works through cooperative mechanisms in which the autonomy of the individual, be it cell, organ, organism, species, or community is qualified toward the survival and evolution of higher levels of order culminating in the biosphere. Now these symbiotic relationships are beneficial to the sum of organisms although clearly many of them are detrimental to individuals and species. While the prey is not pleased with the predator or the host far from enamored of the parasite or the pathogen, these are regulators of populations and the agents of death—that essential return phase in the cycle of matter, which fuels new life and evolution. Only in this sense can the predator, parasite, and pathogen be seen as important symbiotic agents, essential to the creative processes of life and evolution. If evolution has proceeded from simple to complex, this was accomplished through symbiosis. As the number of species increased, so then did the number of roles and the symbiotic arrangements between species. If stability increases as evolution proceeds, then this is the proof of increased symbiosis. If conservation of energy is essential to the diminution of entropy, then symbioses are essential to accomplish this. Perhaps it is symbiosis or, better, altruism that is the arrow of evolution.

This view of the world, creation, and evolution reveals as the principal actors, the sun, elements and compounds, the hydrologic cycle, the plant, decomposers, and the animals. Further, if the measure of creation is negentropy, then it is the smallest marine plants which perform the bulk of the world's work, which produce the oxygen of the atmosphere, the basis of the great food chains. On land it is the smallest herbs. Among the animals the same is true; it is the smallest of marine animals and the terrestrial herbivores which accomplish the greatest creative effort of raising the substance of plants to higher orders. Man has little creative role in this realm although his destructive potential is considerable. However, energy can as well be considered as information. The light which heats the body can inform the perceptive creature. When energy is so considered, then the apperception

of information as meaning, and response to it, is also seen as ordering, as anti-entropic. Noise to the unperceptive organism, through perception becomes information from which is derived meaning. In an appraisal of the world's work of apperception, it is seen that the simpler organisms, which create the maximum negentropy, are low on the scale of apperception which increases as one rises on the evolutionary scale. Man, who had no perceptible role as a creator of negentropy, becomes prominent as a perceptive and conscious being. We have seen that the evolution from the unicellular to the multicellular organism involved symbiotic relationships. Hans Selye has described intercellular altruism as the cooperative mechanisms which make 30 billion, billion human cells into a single integrated organism. He also has described interpersonal altruism. Surely one must conclude that the entire biosphere exhibits altruism. In this sense, the life forms which now exist on earth, and the symbiotic roles which they have developed, constitute the highest ordering which life forms have yet been able to achieve. The human organism exists as a result of the symbiotic relationships in which cells assume different roles as blood, tissues, and organs, integrated as a single organism. So, too, can the biosphere be considered as a single superorganism in which the oceans and the atmosphere, all creatures, and communities play roles analogous to cells, tissues, and organs. That which integrates either the cell in the organism or the organism in the biosphere is a symbiotic relationship. In sum, these are beneficial. This then is the third measure, the bird element, after order and complexity, of the value system: the concession of some part of the autonomy of the individual in a cooperative arrangement with other organisms which have equally qualified their individual freedom toward the end of survival and evolution. We can see this in the alga and fungus composing the lichen, in the complex relationships in the forest, and in the sea. Symbiosis is the indispensable value in the survival of life forms, ecosystems, and the entire biosphere. Man is superbly endowed to be that conscious creature who can perceive the phenomenal world, its operation, its direction, the roles of the creatures, and physical processes. Through his apperception, he is enabled to accomplish adaptations which are the symbioses of man-nature. This is the promise of his apperception and consciousness. This examination of evolution reveals direction in retrospect—that the earth and its denizens are involved in a creative process of which negentropy is the measure. It shows that creation does have attributes which include evolution toward complexity, diversity, stability (steady-state), increase in the number of species, and increase in symbiosis. Survival is the first test, creation is the next; and this may be accomplished by arresting energy, by apperception, or by symbiosis. This reveals an intrinsic value system with a currency: energy; an inventory includes matter and its

cycles, life forms and their roles, and cooperative mechanisms.

All of the processes which have been discussed reveal form; indeed, form and process are indivisible aspects of a single phenomenon. That which can be seen reveals process. Much of this need not be superficially visible; it may lie beneath the skin, below the level of vision, or only in invisible paths which bespeak the interactions of organisms. Yet, the place, the plants, animals, men, and their works, are revealed in form.

All of the criteria used to measure evolutionary success apply to form. Simplicity and uniformity reveal a primitive stage, while complexity and diversity are evidence of higher evolutionary forms: few elements or species as opposed to many, few interactions rather than the multitude of advanced systems. Yet, there is need for a synoptic term which can include the presence or absence of these attributes in form. For this, we can use « fitness » both in the sense that Henderson employs it, and also in Darwinian terms. Thus, the environment is fit, and can be made more fitting; the organism adapts to fit the environment. Lawrence Henderson speaks of the fitness of the environment for life in the preface to his book, *The Fitness of the Environment*.

« Darwinian fitness is compounded of a mutual relationship between the organism and the environment. Of this, fitness of environment is quite as essential a component of the fitness which arises in the process of organic evolution; and in fundamental characteristics the actual environment is the fittest possible abode for life ».

Henderson supports his proposition by elaborating on the characteristics of carbon, hydrogen, oxygen, water, and carboic acid saying, that « No other environment consisting of primary constituents, made up of other known elements, or lacking water and carboic acid, could possess a like number of fit characteristics, or in any manner such great fitness to promote complexity, durability, and the active metabolism and the organic mechanism we call life ». The environment is fit for life and all of the manifestations which it has taken, and does take. Conversely, the surviving and successful organism is fitted to the environment. Thus, we can use fitness as a criterion of the environment, organisms and their adaptations, as revealed in form. Form can reveal past processes and help to explain present realities. Mountains show their age and composition in their form; rivers demonstrate their age and reflect the physiography of their passage; the distribution and characteristics of soils are comprehensible in terms of historical geology, and climate and hydrology. The pattern and distribution of plants respond to environmental variables represented in the foregoing considerations, while animals respond to these and to the nature of the plant communities. Man is as responsive, but he is selective; the pattern and distribution of man is likely to be comprehensible in these same

terms. The term « fitness » has a higher utility than art for the simple reason that it encompasses all things—inert and living, nonhuman, and those made by man—while art is limited to the last. Moreover, it offers a longer view and more evidence. Nature has been in the business of form since the beginning, and man is only one of its products. The fact that things and creatures exist is proof of their evolutionary fitness at the time, although among them there will be those more or less fit. There will be those which are unfit and will not persist, those are the misfits; then, those which are fit; and finally, the most fitting—all revealed in form. Form is also meaningful form. Through it, process and roles are revealed, but the revelation is limited by the capacity of the observer to perceive. Arctic differs from rain forest, tundra from ocean, forest from desert, plateau from delta; each is itself because. The platypus is different from seaweed, diatom from whale, monkey from man... because. Negro differs from Oriental, Eskimo from Caucasoid, Mongoloid from Australoid... because; and all of these are manifest in form. When process is understood, differentiation and form become comprehensible. Processes are dynamic, and so coastlines advance and recede as do ice sheets, lakes are in process of filling while others form, mountains succumb to erosion and others rise. The lake becomes marsh, the estuary a delta, the prairie becomes desert, the scrub turns into forest, a volcano creates an island, while continents sink. The observation of process, through form and the response, represents the evolution of information to meaning. If evolutionary success is revealed by the existence of creatures, then their fitness will be revealed in form; visible in organs, in organisms, and in communities of these. If this is so, then natural communities of plants and animals represent the most fitting adaptation to available environments. They are most fitting and will reveal this in form. Indeed, in the absence of man, these would be the inevitable expression. Thus, there is not only an appropriate ecosystem for any environment, and successional stages towards it, but such communities will reveal their fitness in their expression. This is a conclusion of enormous magnitude to those who are concerned with the land and its aspect: that there is a natural association of creatures for every environment. This could be called the intrinsic identity of the given form. If this is so, then there will be organs, organisms, and communities of special fitness, and these will, of course, be revealed in form. This might well be described as the ideal. The creation of adaptations which seek to be metaphysical symbols is, in essence, the concern with representing the ideal. Adaptation of the environment is accomplished by all physical processes and by all life. Yet, certain of these transformations are more visible than others, and some are analogous to those accomplished by man. The chambered nautilus, the bee, and the coral are all engaged in the business of

using inert material to create adaptive environments. These reveal the individual, a society, or a population. Can the criteria of fitness be applied then to the artifact? We can accept that the stilt's leg, the flamingo's beak, and the mouth of the baleen whale are all splendid adaptations, and visibly so. It is no great leap to see the tennis serve, the left hook, and the jumping catch, as of the same realm as the impala's bound, the diving cormorant, or the leopard's lunge. Why then should we distinguish between the athletic gesture and the artifacts which are employed with them: the golf club, bat, glove, or tennis racket? The instrument is only an extension of the limb. If this is so, then we can equally decide if the hammer and saw are fit, or the knife, fork and spoon. We can conclude that the tail powered jet is more fit for the air than the clawing propellers. If we can examine tools, the we can as well examine the environments for activities: the dining room for dining, the bedroom for sleeping or for loving, the house, street, village, town, or city. Are they unfit, misfit, fit, or most fitting? It appears that any natural environment will have an appropriate expression of physical processes, revealed in physiography, hydrology, soils, plants, and animals. There should then be an appropriate morphology for man-site, and this should vary with environments. There will then be a fitting-for-man environment. One would expect that as the plants and animals vary profoundly from environment to environment, this should also apply to man. One would then expect to find distinct morphologies for man-nature in each of the major physiographic regions. The house, village, town, and city should vary from desert to delta, from mountain to plain. One would expect to find certain generic unity within these regions, but marked differentiation between them. If fitness is a synoptic measure of evolutionary success, what criteria can we use to measure it? We have seen that it must meet the simplicity-complexity, uniformity-diversity, instability-stability, independence-interdependence tests. Yet, in the view of Dr. Ruth Patrick, as demonstrated by her study of aquatic systems, these may all be subsumed under two terms: ill-health and health. A movement toward simplicity, uniformity, instability, and a low number of species characterizes disease. The opposites are evidence of health. This corresponds to common usage: ill-health is unfit; fitness and health are synonymous. Thus, if we would examine the works of man and his adaptations to the countryside, perhaps the most synoptic criteria are disease and health. We can conclude that which sustains health represents a fitting between man and the environment. We would expect that this fitness be revealed in form. This criterion might well be the most useful to examine the city of man: wherein does pathology reside? What are its corollaries in the physical and social environment? What characterizes an environment of health? What are its institutions? What is its

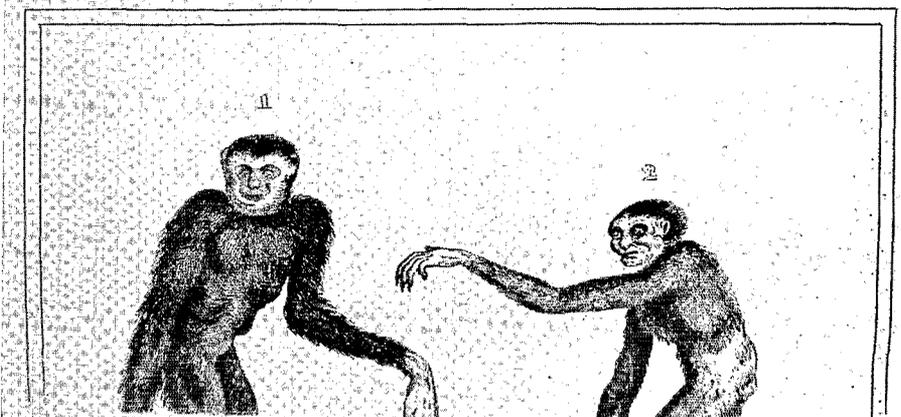
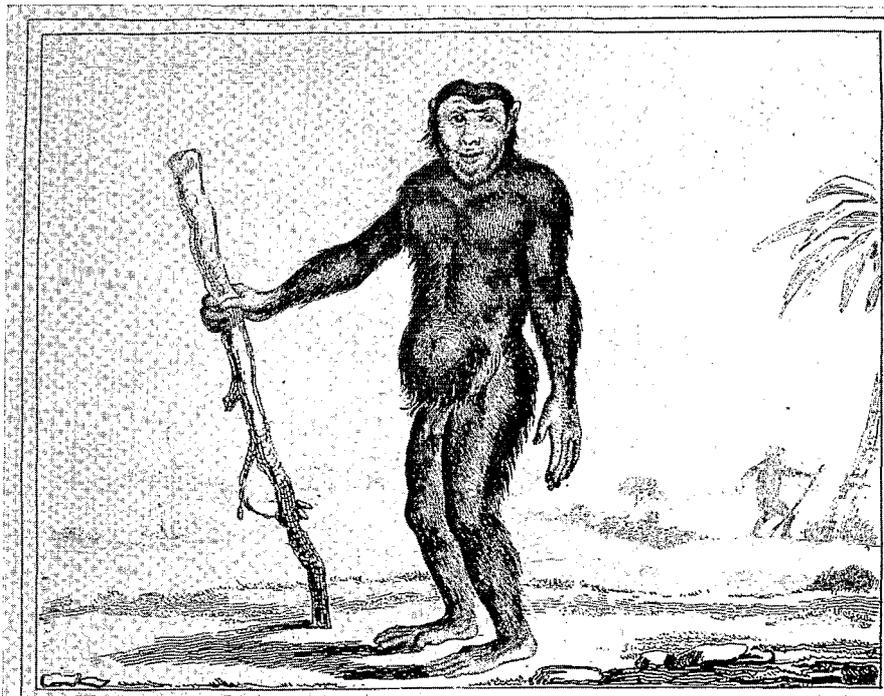
form? Know this, and we may be able to diagnose and prescribe with an assurance which is absent today.

What conclusions can one reach from this investigation? The first is that the greatest failure of western society, and of the post-industrial period in particular, is the despoliation of the natural world and the inhibition of life which is represented by modern cities. It is apparent that this is the inevitable consequence of the values that have been our inheritance. It is clear, to me if to no one else, that these values have little correspondance to reality and perpetrate an enormous delusion as to the world, its work, the importance of the roles that are performed, and, not least, the potential role of man. In this delusion the economic model is conspicuously inadequate, excluding as it does the most important human aspirations and the realities of the biophysical world. The remedy requires that the understanding of this world which now reposes in the natural sciences be absorbed into the conscious value system of society, and that we learn of the evolutionary past and the roles played by physical processes and life forms. We must learn of the criteria for creation and destruction, and of the attributes of both. We need to formulate an encompassing value system which corresponds to reality and which uses the absolute values of energy, matter, life forms, cycles, roles, and symbioses.

We can observe that there seem to be three creative roles. The first is the arresting of energy in the form of negentropy, which offers little opportunity to man. Second, is apperception and the ordering which can be accomplished through consciousness and understanding. Third, is the creation of symbiotic arrangement, for which man is superbly endowed. It can be seen that form is only a particular mode for examining process and the adaptations to the environment accomplished by process. Form can be the test used to determine process as primitive or advanced, to ascertain if they are evolving or retrogressing. Fitness appears to have a great utility for measuring form: unfit, fit, or most fitting. When one considers the adaptations accomplished by man, they are seen to be amenable to this same criterion but, also, synoptically measurable in terms of health. Identify the environment of pathology; it is unfit, and will reveal this in form. Where is the environment of health—physical, mental, and social? This, too, should reveal its fitness in form. How can this knowledge be used to affect the quality of the environment? The first requirement is an ecological inventory in which physical processes and life forms are identified and located within ecosystems, which consist of discrete but interacting natural processes. These data should then be interpreted as a value system with intrinsic values, offering both opportunities and constraints to human use, and implications for management and the forms of human adaptations.

The city should be subject to the same inventory and its physical, biological, and cultural processes should be measured in terms of fitness and unfitness, health and pathology. This should become the basis for the morphology of man-nature and man-city. We must abandon the self mutilation which has been our way, reject the title of planetary disease which is so richly deserved, and abandon the value system of our inheritance which has so grossly misled us. We must see nature as process within which man exists, splendidly equipped to become the manager of the biosphere; and give form to that symbiosis which is his greatest role, man the world's steward.

Photo Collection Violet



Le Jocko (ordre des quadrumanes)