Life

Introduction

Life is surely the most wondrous yet simultaneously the most elusive of all the world's mysteries. It is nature's sanctum sanctorum, omnipresent yet unbreachable, inestimable source of her manifold variety and complexity, hidden cause of her ceaseless metamorphoses. From the invisibly small swarm revealed to the enlarging lens, through the plant world's endless diversity of form and the awesome, beautiful, ridiculous or bizarre creations of the animal kingdom on up to the kingly countenance of the human being, life pours forth a dynamic wealth of being that can perhaps only fully be appreciated in its stark contrast to the lifeless poverty of the other planetary bodies of our solar system. Life's influence even transforms the inorganic Earth. The shimmering ores of metal, creamy formations of marble and even the delicate balance between rainfall and sunshine that allows the rainbow's etheric-heavenly colours to arise are all life's generous gifts.

Whence comes the life that transforms our world? What gives it the power to take hold of and shape lifeless substance – the fixity of rock, water and air – to its will, and even to imbue these elements with vital powers of growth, metamorphosis and – O heavenly mystery – reproduction, so that such a plethora of vigorous evidences of her realm's formative powers fill, invigorate, gladden and enchant our senses? Whence come these very powers that allow the living organism to develop, flourish and endure? Whence the balance between these that holds back the protean impulse once a successful form has been achieved, checks the impulse of continual growth to allow for cessation and death – thus making room for new life – and modifies the powers of reproduction to preserve and stimulate diversity?

Questions abound. What is life's true nature? Its origin? Its purpose? What is the ultimate potential arising from its expressive impulse? Where lie its boundaries: to the realm of the lifeless, physical world below, to the animate world that surpasses it by being imbued with soul, perhaps even with conscious spirit, above? What influences are exchanged at these boundaries, and how? Or is life's existence independent of its neighbouring realms despite its perceptible manifestation in organs synthetic of all the realms of being, for example in the physically grounded, living and growing, soul-imbued and spiritually self-aware human being? Whence comes the grandeur of life's revelation: the iris's depths, the lily's purity, the rose's flame – or the peacock's splendour? Whence its intricacy – the perfection of the gingko leaf, the harmony of the apple tree, the fantastic form of the lobster or rotifer? Whence its essential vitality that allows a great plant to spring from a tiny seed, from the humble acorn a mighty oak to grow?

Though natural science continues busily to knock at life's portals from without, patiently exploring and measuring, defining and theorizing, it has not yet achieved admittance to the holy of holies, the essence and principle behind the outer show. All carefully quantified particulars garnered through scientific investigation in such massed array seem to dissolve into insignificance before life's unpredictable *qualitativeness*, her richness and wholeness. Science's standard array of tools, number, measure and weight, are parameters irrevocably bound to the physicality of the world, to a realm capable of being analyzed into abstracted, isolated details. However usefully they define the range and

character of its physical manifestations, these tools are ultimately inadequate to any comprehension of life's essential being.

The sense of awe and wonder that life's glory calls up in us is gradually being lost as countless abstractions, automations and reproductions of the man-made world progressively absorb human consciousness. Intellectual reflection fills our daily life to such an extent that it effectively screens out the inscrutable, ineffable yet vibrant and perpetually metamorphosing reality of the living world. The ancient Greeks described nature's gestalt as the veiled Isis and warned: *No mortal may lift her veil*. They brought to expression thereby a deeply rooted, and in a certain sense eternally justifiable feeling that to penetrate the outer appearances of the living world, to seek entrance into and gain mastery over the powers of life and death, is to breach an inviolable boundary. It is for this reason that images of such violations – of Homonculus, Golum and Frankenstein, on the one hand; of the modern experimental use of human embryos and gene manipulation, on the other hand – seem to us so eerie, awful and foreboding of doom.

The last decade has seen the advent of technology which can determine, exchange and reproduce the hereditary basis for any living organism, whether plant, animal or man. This new capacity has thrown into question the future nature of evolution: to what extent will mankind take this into its own hands? Will an increasing range of cultivated plants and domesticated animals be artificially bred, genetically altered, 'customized' creations? Will mankind begin to treat its own offspring in this same manner?

Many sense great dangers lurking here. Others sense enormous opportunity. Certain is that the use of this technology is fundamentally and irrevocably altering the nature of the earth's genetic treasure. Is this the greatest hubris yet, an interference with the substance of creation itself and punishable by the revenge of the gods, or by natural catastrophes of unimaginable scale which will inevitably be thereby unleashed? Or is it possible to find a responsible and appropriate place and use for gene technology – more generally, for our increasing control over the evolution of the natural world?

In polar contrast to such images of the debasive manipulation of life stands the Christian image of the resurrection of Lazarus, the sacrificial redemption of death. If we are indeed to achieve mastery over life and death – and it seems that this is in a certain sense being given over into our hands now – this mastery must be exercised in such a way as to remain in harmony with nature's true being. A science that disregards the latter – or denies its very existence! – can never achieve a respectful and above all a worthy approach to life and death. The attempt to strip Isis of her veil is a profanation because that veil is not a concealment for, but the revelation of, her true being. To strip it away does not therefore expose, but merely desecrates the latter.

Goethe, who throughout his life stood in deep reverence before this veiled goddess of nature, indicated a way forward here when he described nature as an '*open secret*': Nature has no mystery, however deep, that she does not simultaneously reveal in one of her myriad forms. Every detail, even the innermost of her being, becomes visible somewhere in her form and countenance, this tracery of her veil, her outward show. We need not seek to strip this veil from her, but by heightening our contemplative attention we can come to comprehend and eventually to continue her work. As we extend our consciousness beyond purely abstract considerations and that level of analyses suitable for the non-living world, we can begin to achieve imaginative insights capable of following metamorphoses, not just tracking linear changes, of synthesizing multiple points of view, not just deciding between mutually

exclusive alternatives, and of taking a peripheral, holistic perspective capable of considering subtle, distant and periodic influences, not just those which are gross, proximate and direct. This puts us on a creative level with nature herself. Just as she brings forth creative forms out of a hidden and inexhaustible reservoir of potential, so we begin to tap the same hidden and inexhaustible potential in us. We, too, are part of nature, after all; all that is in her is in us as well! We, like her, can bring forth in a creative act representations that are neither the products of arbitrary fantasy nor barren abstractions of existing things, but which exist in accordance with the principles that underlie the real world without being slavishly imitations of outward forms. Nature's productions both emanate from and reside in the outer world; ours will no less genuinely emanate from that last and best of nature's creations, the human soul, to flourish along with these.

Goethe took a significant first step here when he developed an imagination of the plant's ontological metamorphosis from developed organ to developed organ as a single, unified process. Such an imagination does not contradict the picture of organic growth being genetically determined, but rather fulfils this picture in the deepest sense, giving it an inner significance worthy of nature by bringing together a surfeit of genetic details under the umbrella of the purposeful unity of the organism in a connected way.

Leaf Sequence

Introduction

Historically, mankind's experience of nature and our picture of how the natural world has come into being have evolved through distinct stages. To retrace these experiences and pictures is to retrace the evolution of human consciousness. Each represents a valid mode of perception of the natural, and especially the living world. Each illuminates a unique aspect of the natural world.

The living world appears to us through its seemingly limitless plethora of forms and its seemingly unending continuity of metamorphoses. At every moment a new countenance and countless previously undetected details of her character present themselves to the attentive observer. We are thus faced with the task of organizing and ordering this dizzying array of experience whose never-ceasing fullness and variety would otherwise overwhelm us.

Careful self-observation reveals that *how* we approach the life of nature determines *what* we perceive in or understand of her. The explorer, the artist, the scientist and the farmer will each perceive and comprehend a different aspect of the world's rich panorama. One of nature's earliest and strictest lessons is that the principles by which we seek to comprehend phenomena must themselves be appropriate to the nature of these phenomena, however.

Human cultural evolution has proceeded through a series of momentous stages in its attempts to approach and describe the phenomena of life in an appropriate way. Mankind has sought to apply ordering principle after ordering principle to the created world; as mankind's consciousness has progressed, each of these principles has been successively found inadequate to life's rich flux. The attempts of past cultures to depict the life of nature tend to be viewed by our present cultures as lying somewhere between laughable superstition and lamentable error. It is possible that these are, rather, equally valid approaches from a point of view as difficult of access to our present day consciousness as the farmer's point of view is to the nature conservationist or artist, the artist's to the scientist or industrialist. As we will

explore a series of these stages in the following exposition, it will be well to keep in mind that these are historical experiences described from a modern point of view. Past cultures would not recognize themselves in these descriptions, for they lacked the reflexive self-awareness to portray their own approach to the world. Similarly, they would have been unable to move fluidly between approaches, as will be done here. Self-awareness and flexibility of approach are new and still developing capacities of the modern age.

Creation

An interest in the origin and evolution of life is not new to the modern age. In mankind's descriptions of the origin of the natural world, mythological accounts of creation have clear historical precedence. In these, the origin of the world (of heaven and earth; light and darkness; sun, moon and stars; firmament and dry land; etc.) is attributed to an original creative deed, to an act of transcendent beings: of God or the gods.

A wide variety of mythologies have sought to offer insight into these themes in a way appropriate to an earlier, less rational and analytic condition of consciousness. The origin of these mythologies remains mysterious to modern man as they are evidently drawn from a different and deeper source than the subjective and arbitrary fantasy of a single individual. J.W. Turner has provided us with a powerful image of such a primeval source of inspiration in his painting of Moses experiencing the creation of the world. An awesome play of creative colour surrounds the seer, seated poised with pen and parchment or stylus and stone, as if striving to set down what he is experiencing in the midst of Creation itself.

That a person could experience an event that took place many eons before his or her birth appears paradoxical to the contemporary mind. Without exploring here what path of inner training might enable someone to attain such experiences, it is possible to recognize with Turner that Moses had such inner, visionary capacities that culminated in experiences he was able to record on tablets of stone. Turner depicted a deep reality applicable to all true mythologies: that they are born of actual experiences of the events they describe. Utilizing any other source would have been unimaginable to those who brought such mythologies into the world, just as it would be unimaginable to a modern natural historian to describe nature on the basis of any other source than actual experience. The differences between various mythological depictions are as explicable as the wide variation between various natural historians' descriptions of similar natural environments or species. Different standpoints, backgrounds and perceptive emphases, as well as different moments and contexts, invariably lead to wholly different experiences of the same phenomena.

Every traditional culture has probably had its own creation myth. At the beginning of such myths, generally, stand, on the one hand, spiritual beings, the godhead or origin-giving gods, and, on the other hand, chaos, nothingness or unformed material. *In the beginning God created the heavens and the earth, and the earth was unformed and void.* Into this space of the unformed void the first creative deed is undertaken, awakening a world out of vacant potential.

The sequence of creation that follows varies from mythology to mythology, but soon after the first creative deed invoking a world, life invariably comes to inhabit this world. This can either take the form of an original, generative animal out of which the rest of the world is born (Ymir accomplishes this in the Norse myths) or of the successive creation of various life-forms: grass, trees, fish, birds, crawling and walking animals and finally mankind (as in the biblical narration). It is notable in these mythologies that each being originates through a

unique creative act; in a certain sense, the creator, the creative deed and the existence created form an essential unity at the moment of creation. Each being is brought forth as a completed accomplishment independently of all other beings, a unique impress of the divine worlds upon the realms of manifestation. The heritage of each is directly traceable to the godhead itself.

What is brought forth is itself often considered to be semi-divine; Sun, Moon, Sky and Earth are often (as in the Greek myths) described as beings capable of engendering further creation – both god and created being. The life forms created in these myths are not individual specimens as we see them in the outer world, but the quintessential essence behind these: the archetypal cow, grass, or human being. The sacred element resides in this essence, not in an outward manifestation.

Preformation

A second, more complex and probably historically later developing world-view understands nature as the revelation of a grand, divine plan in which every created being makes a unique, preordained contribution and has a unique, preordained place. This comes to expression in many folk tales devoted to individual natural beings – minerals, plants or animals – and which emphasize the beings' special character, rather than primarily seeking to illuminate its ultimate origin. This mode of experience discovers the harmony that exists in every organism between its outward form, manner of growth, life-style, and mode of consciousness, for the essential nature of an organism finds expression itself in all of these manifestations.

This mode of experience was carried over into a modern, scientific and thus more abstract form by the great natural historian Linnaeus, the founder of modern classificatory natural science. Linnaeus's carefully built-up systematization of the natural world, first into the mineral, plant and animal kingdoms, then into further sub-classifications (the phyla or divisions, classes, orders, families, genera and species, as we now know them) was founded upon a deep sense that the divine order is reflected in the natural world. Linnaeus conceived of the realms of nature as an image of the divine hierarchies with their ordered ranks of seraphim, cherubim, etc., on down to the archangels and angels. This great observer and scientific thinker did not see all of nature's multitudinous creation as a 'buzzing, blooming, confusion' but rather as a systematic organization. Each entity – stone, plant or animal – has a unique and predefined place in this divine scheme. That which gave Linnaeus the power to introduce an essentially ancient idea in a way that has taken deep hold in modern scientific consciousness – a great deal of our modern scientific conception of nature can be traced back to Linnaeus – was his capacity to see the higher order of nature, not mystically, not through ecstatic experience, but as this came to expression in and through the outer forms of the natural world.

Above all else, Linnaeus had a deep sense for what is significant and what superficial amongst nature's abundant revelation. His determinations of the structural factors decisive for the placement of a plant or an animal in a given relation to other life-forms (for example, dividing animals into vertebrates and invertebrates or the categorization of plants according to the organs of reproduction) have proved to be, if not wholly infallible, at least astonishingly capable of withstanding the test of time, despite countless subsequent

discoveries of new species, genera, families, orders, classes, phyla and even kingdoms of nature.[1,2] Linnaeus used exclusively organisms' physical features to determine their place in his classificatory scheme. Nevertheless, a fundamental concordance of bodily form with growth and behaviour is implicit in his work. It is noteworthy that his classifications of the higher plants depended largely upon that area of the plant where a dynamic element enters into the vegetative growth processes, the reproductive organs, where an elementary capacity for movement (opening and closing), sentience (response to the sun or the presence of insects) and interactions with other organisms (in pollination) can be found.

Linnaeus considered nature's vast structure to be objective and eternal. As nature had been created at the beginning of the world; so would it remain until its end. Such a conception of the natural world has been termed 'preformation'. Any conception of the organisms we now find in nature having evolved from earlier conditions and kinds of organisms, and of these continuing to evolve in the future, lay far from Linnaeus's thought world. What he saw and sought to describe was the eternal, but the eternal in its outward revelation: the divine plan in so far as this is perceptible through our senses and conceivable by our systematizing intellect.

Evolution

At a certain historical stage, humanity's conception of the natural world began to shift away from its earlier theological or mythological emphasis. Individuals began to experience their society, themselves and their environment as dynamic and evolving. Rather than a one-time event, creation became to be considered an on-going process that expressed itself in natural beings' capacity to evolve from a lower to a higher condition. Rather than seeing organisms as elements with a static place in a higher order, people began to see them as achieved moments in a process.

From its very beginning, the evolutionary approach believed that there is a goal to natural evolution, and that nature's progress towards this goal is under the guidance of a higher wisdom. Especially in the earlier phases of evolutionary theory, it was assumed that God was the wise director of evolution. Later, many believed that Nature herself possessed an inherent evolutionary impulse.

Oken carefully described the successive stages of animal development on the basis of the structural factors that support progressively higher stages of development, e.g. the gastrointestinal, vascular and nervous systems; the exo- and endoskeleton, etc. To a modern scientist, Oken's descriptions appear burdened by his somewhat mystical bent, his tendency to categorize nature's evolution in systems and cycles. However, his work was a preliminary attempt to systematize evolutionary principles in a way that united the principles behind natural phenomena with the phenomenological appearance, to penetrate to the real principles and systematic behind the evolution of the animal kingdom. His articulation of evolutionary

[1] The traditional division of nature into the mineral, plant and animal kingdoms has been difficult to maintain in the face of organisms that do not fall neatly into any of these categories: viruses, bacteria, amoebae and fungi.

[2] The unraveling of the genetic code has also posed new challenges to Linnaeus's classifications. Scientists are discovering a great deal about organisms' interrelationships and evolution by comparing their genetic material. By and large, however, the results of this research are extending Linnaeus's work rather than fundamentally revising it.

stages showed how each order builds upon the achievements of the previous orders by adding a new organ supportive of a yet higher level of being in the context of an evolution towards an ultimate goal inherent in the living world. Though later scientists disregarded the specifically teleological aspects of Oken's thought, his evolutionary sequence for the animal kingdom corresponds very closely with the modern view.

Haeckel discovered that there is a close correspondence between the historical evolution that has led to a species and an individual organism of that species' development: that "ontogeny recapitulates phylogeny". Investigations in embryology show that 'higher' organisms, such as mammals, pass through embryological stages that correspond functionally, if not literally, to the forms of adult 'lower' organisms, such as fish and reptiles.

The evolutionary viewpoint introduced a very new consideration regarding the human being, namely that man is the result of a path of development that passes through the entire animal kingdom. Vice versa, the entire animal world was conceived as a series of stages towards the goal of bringing forth the human being.

Adaptation

As science became more reluctant to consider elements outside the directly perceptible realities, naturalists seeking to explain the driving force of evolutionary progress shifted their focus away from goals somehow innate to nature or emanating from divine guidance.

Lamarck and Darwin were the most prominent original exponents of adaptive evolution. Lamarck believed that organisms adapt their form according to the environmental conditions they encounter, and that these adaptations could pass on to their descendants. Darwin's careful, systematic observations revealed that individual species often develop in a highly differentiated manner depending upon the local environmental conditions, leading to an often remarkably precise harmony between these conditions and the localized varieties of plants' and animals' physical form, manner of growth and lifestyle (including eating and nesting habits, symbiotic relationships, etc.). He postulated that this harmony arose through those exemplars of a species most adapted to their environment surviving best. Their characteristics would then be passed on to their descendants. (Mendel had already shown that traits were hereditary, being passed on from generation to generation.)

According to the principle of adaptive evolution, the harmony of an organism with its environment arises through selective survival of organisms as they spread into new, or encounter changes in their old habitats. The climate, soil conditions, available sources of water, wind, temperature and light conditions, on the one hand; potential sources of food, predators and other symbiotic or competitive relations with the other life-forms of the environment, on the other hand, lead to a specialization of an organism's inherent genetic range. The whole of evolution is explained simply as the long-term result of organisms' continually adapting their character to best flourish in their environment.

This principle comes up against challenging problems. It must be possible for successive generations of an organism to remain largely true to their ancestral type; the rose-seed grows into a rose, the sheep gives birth to a lamb. At the same time, it must be possible for there to be a certain amount of variation of characteristics from generation to generation. Finally, wholly new kinds of creatures must evolve through such slow variation. We are

asked to believe that the amoebae can evolve into the human being merely by mechanisms of selective survival, as the cumulative result of gradual adaptations of individual character traits.

The last century saw amazing progress in discovering the genetic basis for preserving, as well as allowing for variability in, species' traits. In contrast to this, neither palaeontology nor observed evolutionary changes in modern organisms have been able to support the assertion that selective evolution can transform one species into another.

Lamarck was perhaps the first to characterize natural evolution as being stimulated by organisms' contact with the outer environment rather than by an immanent or transcendent evolutionary impetus, to look for the stimulus for evolutionary progress, not within, but external to the organism itself. Darwin became the most famous advocate of the theory, adding his long famous, now increasingly severely tested principle of the survival of the fittest. Early proponents of adaptive evolution, including Lamarck and Darwin, assumed that influences from the environment formed an organism's somatic (bodily) traits in an inheritable way. Later, natural variations in the genetic determination of traits, the survival of which depended upon their viability in the environmental context, took over as the accepted explanation of adaptive evolution.

Darwin described the striving for environmental viability in competitive terms, and for a long time this defined evolutionary scientists' thinking about evolution. Principles of cooperation and symbiosis are now being increasingly emphasized as equally important factors in the survival of species. James Lovelock and Lynn Margulis, also known for their work on the "Gaia Hypothesis," are perhaps the most significant contemporary proponents of a collaborative view of evolution. In both models of species survival, the competitive and collaborative, the outer environment determines the path evolution takes.

Summary

The various approaches to life articulated above – the mythological, preformational, evolutionary and adaptive – depict the organic world from distinct points of view. When we take them seriously, we can also gain insight into the development of human consciousness.

The mythological point of view focuses on the ultimate source of natural being in the divine being and upon the unique relation of the created world to its creator. The original act of creation irrevocably unites the creator and the creature. This point of view is the expression of a culture's relation to the world, of a mode of experience natural to the peoples of ancient cultures but extremely difficult for modern man to enter into. If we seek to enter into this experience, we become filled with wonder and thankfulness for the existence of the world's manifold being. Our awareness of the divine presence becomes universal and inseparable from 'outer' experience. The divine indwells the created world; the created world exists solely as an emanation of divinity.

As unreflected experience, this is not just one possibility; it is the archetypal and original meeting of the human being with the natural world. It irrevocably unites the reality of the experiencing individual and the reality of the being perceived.

Our inner experience moves from experiencing oneself as a direct creation of God and one's whole existence and life as a direct emanation of the divine world to experiencing oneself as a part of the larger divine plan and order and thus one's interrelationship with all of creation. Compared to this mythological unity, the experience of all being having a

preordained place in the grand plan of creation has a less immediate quality. Each being's relationship to both the grand system of creation and to all other beings becomes significant. Preformation illuminates the natural order as an emanation from or revelation of the divine order; as every creative power (divine being), so every creature (natural being) has its allotted place in the grand cosmic scheme. We celebrate the uniqueness of each being, while gaining an enhanced awareness of the interrelation of all beings. We become conscious of having a predetermined role to play in the world.

The next step of experience intensifies the image of the inter-relatedness of all being from that of a static organization to that of a dynamic, causal evolution. All beings are experienced as fulfilling their part in the great impulse of evolution; each receives the basis for its existence from its precursors, and in carrying this impulse a stage forward supports the development of its successors, at the same time being carried forward in dynamic exchange with these. Progressive evolution follows the developmental stages by which natural beings evolve, either through the influence of a transcendent directive agency, or through an innate evolutionary impulse. A progression of being appears upon which all of creation finds a higher or lower rung according to its developmental stage. This nourishes a feeling for the developmental movement that connects all of life. We become conscious of our own position on the ladder of evolution.

Adaptation shows how natural beings modify their external traits to suit their local environment, differentiating individual varieties in response to existing conditions. We seek to find plausible physical mechanisms for this differentiation, discovering the genetic expression of the life processes and the principles that lead to the survival of traits. We focus on the relation of natural beings to their physical environments, thus coming to better understand and appreciate the integrative relationship between ourselves and our own environment.

Creation, preformation, evolution and adaptation are significant and valid ways of perceiving the world around us. Any organism or life form has its ultimate origin in a creative act of divine being, has a place in nature's overall organization, expresses a certain evolutionary stage and adapts to its surrounding environment. In addition, however, nature's objective evolution has passed through these four stages. The world originally arose through a creative act of a divine Being. Through the work of the spiritual hierarchies, orders of natural being arose. The natural world had immanent within it an evolutionary capacity sufficient to bring the realm of life to its present evolutionary stage. Once evolved, organisms engage in adapting their traits to their environment.[3]

External nature no longer has the forces necessary to encourage a healthy, progressive process of adaptation and specialization. This is partly, but only partly, the result of the worldwide scale of human influence, in many ways despoiling nature's countenance, rhythms, harmony and integrity. The processes of adaptation and specialization would have come to a natural conclusion in any case, however; there is only so far that adaptive specialization can go before reaching a limit beyond which continued adaptation (especially to a disturbed natural environment) and specialization (at the risk of losing the flexibility to adapt to new and changing environments) tends to result in the degeneration or extinction of the natural type.

Adaptive evolution can no longer generate an essentially new contribution to the general evolution of life; it can only specialize and narrow the capacities of already evolved life forms through making them more closely conditioned to particular environments. It is useful in this respect to compare the first stages of embryonic growth – which result in universal features and stages of development – and the latter, specializing stages, where the universal potential and evolutionary impetus is lost and a more particularized form taken on. Though these two phases are not always precisely chronologically separable, they are functionally distinct, and the *functional* transition from the universal to the particular phase represents the first tendency towards senescence.

What will be the future of life now that the physical world's potential for furthering evolution is rapidly coming to an end? All of life, and thus all of nature, must fall into evolutionary decline unless a new element rises up from within nature itself, an element capable of establishing and sustaining a new evolutionary impulse. If such an element is not to come from the old sources of life's origin and development, from newly original creative acts or the ordering, interweaving influence of the divine world, nor from life's immanent evolutionary impulse nor from the physical environment, whence can it come?

Parallel to this question is the question of how mankind's consciousness of and attitude to nature will now evolve. These two questions have always been deeply intertwined. The modality of their relation is shifting, however. As mankind first evolved, natural evolution determined the evolution of human consciousness. It will increasingly be the other way around: the evolution of human consciousness now begins to determine the course of nature's evolution. We stand at a historical cusp.

[3] These stages manifest functionally. Evolutionary directions, not necessarily the completed results of these directions, manifest in embryological development. We go through a fish-like stage in the womb, but do not achieve true gills, nor does the embryo pass through a stage of being feathered and winged.

The question is, how will we go forward from this cusp? Human beings are achieving both outer and inner independence from nature. This independence can be experienced as isolation and can manifest in a capacity to systematically destroy nature's health. It can also show itself in the self-awareness capable of assessing and the flexibility of action capable of transforming the natural world in positive ways, however.

This conscious relationship to nature found its first beginnings in Greek philosophy. Aristotle's treatise *De Anima* established a new kind of philosophising over nature, that of scientific investigation. This new kind of thinking provided the basis for a new kind of transformative activity in nature, a new kind of farming, which culminated in the cultivation and selection of domesticated plants and animals practised during the twelfth to fifteenth centuries by the Benedictine monks, especially the Cistercians. Traces of their agricultural efforts are to be found everywhere they worked. These were by no means restricted to the land within the monastery walls; the landscape for great distances around was often transformed through the radiating effects of these monks' work. Examples of this include the preservation and expansion of farmland through dyke-building in the Netherlands and the hedgerow-bounded field-organisms of Britain and France. Individualizing a 'farmscape' and its various elements (land, cultivated plants, farm animals and including an ennobling of the farmer both humanly and professionally) was a central aspect of their work.

The following table gives an impression of the enormous transformation in the relationship of the human being to the natural landscape. (Margulis and Sagan, 1986, p245)

Human Culture	**Land Needed to Support One Person**	**Time**
Paleolithic hunters	1000 hectares	35,000 years ago
Neolithic cow-plow peoples	10 hectares	8,000 years ago
Medieval peasants	0.67 hectares	1,000 years ago
Indian rice farmers	0.20 hectares	100 years ago
Japanese rice farmers	0.064 hectares	1980s

We now bear that responsibility for natural evolution once borne by the creator, by spiritual beings, by nature's immanent capacity for self-evolution, and by the influence of the physical environment. Whether we recognize and how we use this responsibility now lies within the realm of our free will. We are no longer determined by an un-free, given, or 'natural' connection with the world around us, just as we no longer live in a way determined by the religious experience that once dictated the cycles of man's being, even into the agricultural methods and practices (sowing and harvesting times, etc.). It lies in the nature of such freedom that its potential to be abused is precisely equal to its capacity to be used to uplift nature and ourselves, however. Just as the human being has, by stages, become free of an unconscious integration into the surrounding natural environment, resulting in our present uncertainty of how (or if!) to relate to her, so can, by stages, a consciously-willed reintegration be achieved through inner and outer transformation: through work on ourself and the world.

Especially during Greek and somewhat less during Roman and medieval times, nature was still experienced as, or, later, at least still regarded as being ensouled. Living creatures were considered beings with a higher nature than their purely visible, outer aspect revealed. Work with nature – including evolutionary efforts – was undertaken out of this consciousness

and in a kind of collaboration with these beings. A last echo of such collaboration is to be found in such figures as *Luther Burbank* and *George Washington Carver*, whose work in plant breeding went hand-in-hand with a semi-mystical awareness of the natural realms.

With the rise of the more abstract-scientific consciousness of the modern day, introduced by the Renaissance, all being not reducible to or discoverable in nature's outer shell and appearance began to be excluded, first from scientific discourse, then from all discourse. Work with nature and its evolution inevitably took a correspondingly abstract direction.

The first step was to seek to control plants' and animals' development in an artificial way through artificial, standardized nutrition and environmental conditions. This began with chemically fertilized soil treated to be weed-free and culminated in hydroponic growth environments, where a chemical soup filtering through sterilized sand in artificially lit greenhouses offers an absolutely controlled, mechanized environment; animals were increasingly given synthetic feeds, including growth stimulants and disease suppressors, while being housed in standardized pens that prevented all, movement, mutual contact or exposure to anything outside of the mechanized environment, including the land, health-giving wild plants, sunshine, etc.

As a response to such abuse of nature – for it cannot be considered anything less than this – the preservationist or naturalist movement came into existence, seeking to create areas where man's influence was held to a minimum. Enormous stretches of land are now dedicated to maintaining nature in its 'wild' state in nearly every country of the world. Since the human being was, always and everywhere, one of the central factors in the evolution and balance of nature, this 'wild' state is, in reality, simply a progressive decadence from the point at which man's *positive* influence ceased.

We are part of nature; to exclude our own positive contributions is to rob nature of an irreplaceable element in its development and subsistence. This will become increasingly apparent in the future. It is ironic that the need for such preserved areas arises only in places where the abuse of nature has reached a certain culmination; in traditionally cultivated landscapes, a healthy balance is achieved inclusive of the human factor. It is apparent that separating the natural landscape into areas of abuse and areas of preservation is no long-term solution to the challenge of finding a new relationship to nature; nor can a return to traditional life-styles be seriously proposed now. Our whole consciousness and evolution demands a new, freer and more conscious relationship to nature than such traditional frameworks allow. Where can the solution then lie?

Initially, this responsibility has been and will be carried by consciously establishing new natural environments and new processes of adaptive selection. The development of the farm as an *artificially healthy* environment for life, rather than the direction it seems to have increasingly been taking over the last century, an artificially *unhealthy* one – as an environment *more* supportive of life's continued, positive adaptive evolution than untransformed, wild nature now can be, rather than less so – is one side of this impulse: no longer to depend upon nature's capacity to provide the environment needed for the on-going adaptive evolution of the cultivated plant and farm animal, nor to simply destroy this environment further while bilking the maximum possible gains out of steadily degenerating life-forms, as our factory farms seek to do. Modern hybrid strains of wheat last but a short time – relatively few years – before losing their vitality and needing to be replaced by new

strains; the high-yield milking cow is increasingly dependent upon high-protein, animal-based feeds and subject to terrible degenerating illnesses. This path presents no viable future.

Characteristic of the accomplishments of the first stage of humanity exercising an independent responsibility for the health and evolution of nature was an emphasis on the interrelationship between organisms and their environment. This could take the form of modifying the physical environment, as in the reclamation of land through dykes, the organization of the landscape into fields through hedgerows, or the transformation of forest into pasture. This was an enormous step from the existence in, adaptation to, and dependence upon the existing landscape characteristic of traditional cultures (and still visible today, for example where the American Indian, the horseman of the Hungarian pusta or the Chinese rice farmer has preserved the age-old lifestyle of their ancestors). Deep-reaching alterations in landscape were not only largely beyond the power of earlier civilizations – though civilizations capable of building the Pyramids or the Great Wall of China could certainly have accomplished significant transformations in landscape as well –; above all, such transformations were essentially foreign to earlier civilizations' consciousness, their relationship to and experience of nature as a given and semi-divine element.

A second form in which this new relationship to nature manifested was the conscious cultivation or adaptation of varieties and breeds to suit a particular environment, locality or situation. New crop varieties (e.g. cereals, vegetables and fruits) and new breeds of domesticated animals (dogs, horses, cattle, etc.) were developed to suit and capable of flourishing in various environments. The evolutionary process of adaptive specialization thus began to be encouraged and directed by human agency. Up until fairly recent times – certainly up through the 15th century – this was accomplished out of a consciousness of the essential unity of all life with its environmental context. Since that time, however, humanity has projected its sense of disconnection with and thus freedom from the environmental context onto nature, as well. Attempts to modify landscapes and breed organisms have increasingly been context-free and thus insensitive to the interrelationships that necessarily exist between any life-form and its surroundings, and more generally between the various elements of a biotope: the landscape, flora, fauna, climate, etc.

Attempts to influence evolution have thus moved from a focus on specialization with the aim of increasing integration with the existing environmental context towards a focus on influencing or modifying the essential nature of organisms independently of or even in defiance of their context.

This is a new kind of task. Part of the crisis in modern agriculture is that this task has been approached with techniques of physical manipulation more appropriate to modifying the physical landscape. As they have become more insensitive to the environmental interconnections in which all living organisms exist, these techniques have become more brutal. Techniques such as scorching the soil to repress weeds, applications of artificial fertilizers, pesticides, herbicides and fungicides, high-protein feeds, hormones and antibiotics, artificially-conducted cross-fertilizations (hybridisation) and gene manipulation all attempt to manipulate the organism in defiance of or independently of its environmental context. The short-term efficacy of such techniques is in proportion to their powerful application; their medium- and long-term weaknesses reflect the lack of holistic or contextual thinking behind them. Hybrids are generally weak and quickly lose all vitality (new strains of hybrid wheat, for example, must be regularly developed as the old strains

weaken); poisons and artificial fertilizers destroy the native soil fertility and the organisms which support this (such as earthworms); hormones, antibiotics and high-protein, often animal-based feeds alter the healthy balance of the animal organism and thus its capacity to resist illness, the latter even carrying factors that actually degrade the organism's tissue, culminating in such terrible and often epidemic conditions as hoof-and-mouth disease and Bovine Spongiform Encephalopathy. Antibiotics also encourage adaptive evolution of new strains of disease-carrying bacteria.

Above and beyond the particular problems such an approach reveals, we have to a certain extent exhausted nature's potential for substantial progress through adaptive evolution. On the one hand, the environment itself is becoming increasingly unhealthy on a global scale due to human influence: acid rain, polluted air and water, poisoned earth, the wide-spread destruction of natural habitats rich in diversity of species and their replacement with highly controlled environments with extremely poor diversity of species (monocultures) and the concomitant loss of accompanying organisms such as birds and butterflies. Due to nature's inherent interconnectedness, in the context of global environmental disaster local attempts to improve conditions are necessarily limited in their capacity to provide healthy contexts within which adaptive evolution can take place in a positive way.

On the other hand, specialization has achieved a great deal, but the more specialized a variety or breed, the less its potential for further adaptive evolution (or evolution of any other kind). From the wild dog or wolf came all of our domesticated species; from the wild cereals or grasses all of our cultivated forms, but, being already highly specialized, the St. Bernard dog or Canadian red winter wheat is not capable of a great deal of further evolution. Amongst breeders, there is an increasing tendency and necessity to reach back to earlier, relatively unspecialised forms in order to find evolutionary potential.

Finally, man now so rules the natural world that the latter's own evolutionary potential is largely dependent upon arbitrary human choices; not only are there few untouched and untroubled natural environments left on the earth – and those still left are rapidly disappearing – but even the choice of which organisms or species will survive and which will disappear is increasingly in human hands.

We will thus be faced with the task, whether we like it or not, of taking on the larger direction of natural evolution on an evolutionary scale. Not just adaptive specialization: the fundamental direction of nature's evolution will increasingly lie in our hands. The unconscious experience of this necessity has led to attempts to accomplish this evolution through the mechanical manipulation of genetic factors. We will look at such techniques below. After examining these techniques, however, we must turn to the real question of the new millennium: how do we exercise in an appropriate and positive way the evolutionary control or direction that now lies in our responsibility?

Man is the synthesis of all of nature. The microcosm that is man's being and the macrocosm of the world are finely attuned to one another. If we inflict upon outer nature an abstract regimen which distorts its inherent being, we do the same to our inner nature, denying its validity and repressing its natural, healthy existence. If we allow outer nature to descend into wildness, denying it our cultivating influence, we allow our inner nature to do the same and withhold from it the ennobling effects of our higher awareness. This is not merely the result of our consciousness acting simultaneously in both the inner and outer realms, with parallel consequences for each: the objective world that we create – the gene-

modified mono-culture growing in a grey and lifeless soil under an atmosphere devoid of bird, bee or butterfly, moistened by acidic and sulphurous rains and shone upon by a sun no longer beneficent in its effects – or the forest choked with climbing vines and strewn with fallen branches and mouldering trees – or the farmscape of garden, pasture land, orchard and forest in harmonious interconnection and balance – has as objective an effect on the human being through our sense experience as our consciousness, working through our deeds, has objective effects on the world.

The more differentiated an understanding we have for the manifold expressions of nature, the more we begin to comprehend our own being as a highly differentiated entity. The more we experience the fundamental unity of our own being, the more we experience the fundamental unity that underlies nature. Seeking a cooperative relationship with nature, we begin to see in nature not only a battle for existence, but also the cooperative relationships that are often far more important for an individual organism's, species' or biosphere's survival than the competitive ones.

Let us examine some of nature's cooperative capacities. When we look out at a landscape, whether of forest, meadowland or field, we generally see a balance of species growing together. In the forest, for example, high trees give protection to shade-loving undergrowth, while themselves being nourished by fungus hidden in the soil. Insects pollinate the blossoms of the pasture while drinking their nectar; leguminous plants replenish the soil for the grasses, herbs and flowers; birds eat fruits and scatter the seeds into new areas and habitats. Many more subtle relationships are at work as well. Amongst animals, of course, it is obvious that individuals of a single species often come together into cooperative groupings: families, flocks, schools or herds, etc. Cooperative relationships *between* animal species have been less attended to, with a few exceptions: the fish that lives in the mouth of a larger, normally predatory fish, cleaning the latter's teeth, or the honeybird that leads man to bees' nests in exchange for a share in the honey thus obtained.

The classical interpretation of such cooperative behaviour, that it arises and is maintained through the competitive edge it gives, is a distortion of the situation. Cooperation leads *directly* to an enhancement in survival and lifestyle, not merely through the competitive edge that it may also provide. Sociability cannot be explained away as a trait bred by its contribution to the survival of the fittest; it is a universal trait of the natural world.

Man is the highest example of such a potential for cooperation. This is not only true of and evidenced in human society, at its best and most refined an extraordinary interwoven network of mutual support. Human influence is capable of bringing about a cooperative relationship amongst the various kingdoms of nature, as well. The farm is the essential model of such a harmonizing influence of the human being on the natural realms. Historically, nearly every person lived and worked a tended piece of land, whether this was a garden, a smallholding, or a larger area of farmed land and whether this was held in common or under private ownership; those who did not by and large lived in close proximity to such work.

Bringing about a harmonious relationship between the land, plants and animals lies at the heart of any such endeavour. The plants live nourished by the healthy forces of the soil and nourishing the animals. They also revitalize the land in various ways: as aerators of the soil, through compost or, as in the case of nitrogen-fixing plants, through directly building and regenerating soil fertility. The animals shape and order the land from within (e.g. insect life) and without (e.g. ruminants terracing a field); bring form into the plants and distribute

their species, spreading seeds in various ways; they also nourish the land, raising its fertility considerably (this ranges from earthworm castings to cow manure).

In man's work with nature, not only can all of these activities be harmonized; the very nature of these kingdoms can be transformed. A higher 'natural organism' is or can be built up through man's conscious, guiding influence: an organism wherein land, plants, animals and man himself become differentiated, effective organs whose cooperation, like that of the organs within the human organism, leads to a higher order of being, a mutually beneficial synergic relationship that transcends the sum of its parts.

To achieve such a farm organism, it is no longer sufficient simply to modify the outward environmental context. It could be said that the next step in evolution will be to create consciously synergic habitats, transforming the conventional idea of a farm through elevating the interplay of the individual elements – the land, the crops, the farm animals as well as the farmers themselves – to a new, conscious, and potentized level. This will provide the conditions under which organisms – including the earth itself and the human being – may break through to a new evolutionary stage, one that sacrifices competitive for mutually cooperative capacities. The tendency of natural organisms to become specialized to fit their outer environment will thus be progressively transformed into the higher evolutionary goal of the synergic organism, which is not just an environment, not even just a habitat, but a conscious entity working in harmony with and for the benefit for all of its constituent beings.

Such synergic farms have the tendency to progressively incorporate an ever-wider range of organisms in their field of work, as even wild plants and animals – at the extreme, even weeds and predators – express necessary functions in nature, and are part of her cycle. The inclusion of such wild elements in the farm organism – whether through cultivating these to domesticated forms[4] or through absorbing and balance them in other ways (e.g. by supporting bird life capable of combating insect predators) is not an artificial element in an integrated, synergic method of farming that includes the whole environmental context. It will thus ultimately be not only the cultivated elements, but the whole natural realm that will gradually become transformed into a conscious and consciously synergic entity. The entire organism will begin to take on the *form* of a conscious organism through this transformative work. This will allow higher beings to work into such an organism in a new, free cooperation with both man and a nature now independent of the spiritual world.

The individual soil, plant and animal types or species will thus, like the human liver or lung, serve as specialized functional organs of a larger organism, the farm. Therein lies the redemption of the creatures that have sacrificed themselves by becoming (over-)specialized to the extent that they are no longer capable of further evolution as independent beings, in order to allow higher creatures – including the human being – to develop further. Such specialized organisms are brought back into in the evolutionary stream by being included in the unspecialized whole, the adaptable organism of the biodynamic farm, which, as it includes representatives of all of nature's realms, though naturally manifesting at any particular time in a particular gestalt, form and organization, is a context capable of evolving organically in any direction.

The coming millennium will see the rise of a great many agricultural organisms of this kind, wherein the human being works with nature to establish a new, dynamic cooperation between and within the natural realms. In order to achieve this, a new sense of

[4] The wolf was once made into a dog that protects the flock, the wild horse into a cultivator of the land. Grasses were bred to cereal crops, giving them new forces to feed both animals and man.

connection with the spiritual worlds will also be necessary. For the first time, we have the potential to nourish nature, rather than simply be nourished by her forces: to harmonize and order the beings of her realm in a consciously creative way. For this, we will need to draw on a new source, a source not to be found in the outward realms of nature but bearing within it principles capable of invigorating and transforming these realms. Each of the organic entities born out of conscious work with nature will be a unique creation arising out of both the earthly constellation of geology, flora, fauna, and the farmers' practical faculties as well as the heavenly constellation of spiritual beings behind the work, including the farmers' insight, ideals and purpose. Human beings will thus serve to reunite the natural and spiritual worlds, enabling higher beings to work with nature through them, raising nature to become a truly free and equal partner in the larger work, allowing nature to continue to receive the forces of a spiritual world which is itself continually evolving.

Every garden or yard, park or woodland, farm or forest must ultimately be transformed in this way to become a consciously nurtured biotope, a consciously evolving organism. Such higher organisms will work back upon the plants and animals within their sphere, bringing a new impulse into the latter's organic evolution and providing the conditions necessary for their healthy further development.

The symbiotic landscape thus created is a prefiguration of the biblical prophecy, *'and the wolf shall also dwell with the lamb, and the leopard shall lie down with the kid; and the calf and the young lion and the fatling together; and a little child shall lead them…and the lion shall eat straw like the ox.'* (Isaiah 11.6-7) Though this may seem distant and improbable, it is worth noting that the wolf – in the transformed guise of the sheepdog – already lies down with the lamb on many farms. Human influence is capable of achieving astonishing results in harmonizing nature. It is now a matter of extending what has already been achieved into the new demands of the contemporary world.

Nature has reached a turning point. In order to continue evolving at all, it must rise to the higher level of development of bio-dynamic interdependence; otherwise, it will lose all capacity to support its own – and that includes the human being's – further development.

Certain conditions of soul are necessary prerequisites for the impulse towards this new evolutionary breakthrough to flourish. Human thinking must find a way beyond the abstract approach of conventional natural science, recognizing in nature's phenomenological appearance a level of reality at least equal to that of our conceptual models of this appearance and becoming capable of perceiving nature as a partner, not just an object. An Eastern-mystical element lingers in science just there where it seeks to be most rational, an element that could be characterized as unrealistic and alienated. Such an approach abandons the immediate and experiential reality of the world, replacing this with its artificially constructed explanatory principles.[5] This is not said to diminish the value of theories and models derived in this way, but to clarify their dogmatic and tendentious character and to explain their limited life span. One-sided pictures of reality tend to exclude other theories, approaches or views. When viewed from a holistic perspective, however, even seemingly contradictory views appear as mutually complementary descriptions of different levels of life. A purely phenomenological description of nature is a description undertaken without theoretical bias.

[5] It should be emphasized that all such principles originated as direct intuitions of human consciousness; their justification lies in their offering a true representation of (inner) experience. As the nature of our experience and consciousness changes, however, so must our expressions of these, if they are to remain true and vital, not merely clichéd echoes of received dogmas, whether of scientific or religious origin.

A phenomenological method differs from theoretical explanations or descriptions of the world precisely in that it leaves behind the world of model, hypothesis, theory or predetermined world-view, attempting to characterize rather than define. It attempts to allow phenomena to speak through bringing out the lawfulness or order inherent in their sense-perceptible reality rather than to replace this reality with a conceptual model. Conventional science works by abstracting from observed phenomena with the goal of attaining a theoretical conception of the 'hidden principles' underlying the observable events. It then declares the world of experience and sense perception to be illusion and the concepts and models – though derived from that world – to be reality. Therein lies its Eastern-mystical quality: to deny the reality of experiences of the outer world in favour of images or ideas derived through inner contemplation.

A further prerequisite is for human feeling to develop new social contexts that allow biodynamic organisms to evolve as social entities: a non-suppressive, non-totalitarian, truly tolerant culture within which every initiative is allowed to prove its place. At the moment, even in the supposedly freest of countries, certain cultural directions are promoted, others suppressed or simply ignored so far as possible, independently of the social support or value of the impulse. Political considerations give certain power groups control over which initiatives or social directions will be promoted at the cost of others, rather than allowing all such impulses to prove themselves on an equal playing field, as it were. The respect for the maturity of its citizens in this respect – to allow them to judge for themselves with which cultural impulse they would wish to connect themselves – is the test of the truly democratic, free society, not its capacity to build a broad consensus for a one-sided approach such as lies behind modern, politically directed farming, public education, and medicine, amongst other areas. A totalitarian society is one that seeks to control all realms of life from the political sphere. What is obvious to us as a deep error when applied in countries such as the Soviet Union or Fascist Germany, we are repeating with broad, democratically achieved consensus in the West.

Finally, the human will must seek to rise to a new spiritual connection and understanding. We must go beyond a merely passive approach to all that lies behind religion and spiritual life. It is no longer sufficient to accept others' revelations from this realm, for what once would have been healthy receptivity is now inner laziness; we must become active seekers, wrestling with spiritual questions and developing our own inner capacities in order to make spirituality a matter of real experience. Here, too, an obsolete, Eastern dogmatic element lives in the wish to receive as dogma or revelation from others all that applies to the realm. In ancient times, caste or training led certain people to be able to play the role of priest or hierophant, and thus to achieve experience of the spiritual realm which they could then convey to others. In the present day, the significance of such elements – of birth or of the theological seminar – for the awakening of spiritual faculties is negligible. More and more, each person will be called upon now to achieve such insight for themselves, at least to an extent sufficient to judge for themselves amongst the ever wider and more divergent offerings in the realm of spirituality and religion; not merely to decide which faith, dogma or outer practice to accept, but to come to inner certainty in such matters through testing all that comes from others as spiritual revelation on the basis of one's own experience and insight. So long as I have not yet made something my own, so long as I have not digested it – destroyed it and rebuilt inwardly my own insight regarding it – I am not a free, that is to say a true human being.

Only out of free insight can true creative activity take place. Synergic development can only be achieved through creative activity born of freely exercised insight; no dogma, no intellectualisation can accomplish this. The biodynamic organism of the earth is calling for inwardly free and active human beings, without which it can no longer evolve. Nothing else will do; out of stones, no bread can be made.

Phenomenology

Goethe's studies of how plant species vary according to their environmental context showed how the same species growing in mountain or valley, in North or South takes on a different form. These studies provide us with a perceptive analysis of the relationship of plant growth to environmental conditions.

Bio-manipulation

One of the last century's most significant scientific achievements was the progress from a vague conception of traits being inherited to the postulate of their being passed on by means of a physical transmission, on through the discovery of the chromosomes as the seat of the carriers of this transmission, the clear definition of the organic composition of the genetic material, and on to the still on-going mapping of the chromosomes, defining the interrelationship of sites, functions and genetic content and the development of techniques of implanting genes from one organism into another's genetic structure. In the midst of this progress, popular science, and perhaps even many serious scientists, have lost sight of one of our most important discoveries about the genes: that they do not, as Mendel thought, define physical *traits* – at least not directly – but rather define or stimulate organic *processes* – processes whose results then manifest as formed characteristics. The difference is vital because it is the interweaving of an incredibly complex range of processes that results in the formation of the individual physical organs and attributes. Not only is any single attribute dependent upon the interaction of a great many life processes, but even more significantly, by their very nature, processes are not isolated in their effects; all organic processes interact with and have effects on a wide variety of other processes. This is especially true of nearly related or spatially closely located processes, but ultimately, all aspects of an organism may be said to be affected in some way by changes in any given process, though for some the resulting effect may appear to be diminishingly small.

Attempts at bio-manipulation, or gene technology, have hitherto treated the genes as functional units, like components of a machine, rather than as processual determinants. Components of a machine may be redesigned at will with predictable consequences, so long as the sharply defined boundary of interface with the unmodified remainder of the machine is carefully engineered. Such precisely locatable and definable interfaces are characteristic of the technological world, but absent in the living world. Processual alterations in an organic entity will inevitably result in complex effects, not all of which can be foreseen. Without such a sharply defined border, neither localized effects on other aspects of the organism nor the effects on the organism as a whole (including its form, growth, behaviour, etc.) can be clearly predicted, definitively isolated or known with certainty. It is for this reason that there has never been an allopathic drug without complex systems of unexpected side-effects, for the effects of such an influence can only be determined empirically and post facto. In such a situation, what are called 'side effects' are simply the collection of all that has so far shown up unexpectedly; every new usage will potentially reveal new effects, and virtually always does.

The History of Human Manipulation of Genetic Evolution

The above considerations bring us to the important question of human responsibility for, influence on and consciously undertaken modifications of the beings of nature. An adequate treatment of the full scope of this question would itself alone require several volumes, as it would need to consider natural ecology; environmental care; the balance between preservation of and production from nature; the effects of physical, chemical and biological changes on the natural balance, etc. Here, we will concentrate on one aspect of this, one of the most important of today's challenges: that of direct intervention into heredity, into the genetic stream.

Actually, such intervention has a very long history. Perhaps the earliest known attempts to produce a special strain or breed are those traditionally associated with ancient Persian times, and in particular with the figure of the ancient Persian spiritual leader Zarathustra, founder of the Parsi religion. It was at this time that our modern grains were developed from the grasses and that the domestication and breeding of the horse (the Arabian breeds still remain unsurpassed) was accomplished. (The oldest known reference to the breeding of animals is a more than 3,000 year-old Hittite document describing horse breeding.) Other examples that show evidence of being the result of early species development through human influence include the fruit trees (apple, pear, cherry, plum), the onion (garlic, onion, leek), and the cabbage family (cauliflower, broccoli, Brussels sprouts, kale, cabbage, kohlrabi). In historical times, the Cistercians, who transformed the landscape of much of Europe, systematically bred varieties of crops and breeds of domesticated animals to be suitable for local conditions. The St. Bernard dog is perhaps the most famous example among many that simply entered into normal usage, for the use of such varieties and breeds spread far beyond the monastery walls.

Two traditional directions can be seen in the above examples of species development. The one is breeding to strengthen or bring out a particular process or aspect of an organism: in the plant, seed formation (wheat and other cereals), fruiting (apple), flowering (cauliflower), budding (broccoli), leafing (kale), stem growth (leek), budding or bulb process (onion) or rooting (kohlrabi). In the animal, this takes the form of cultivating a particular instinct and its corresponding physical manifestation, e.g. protective, hunting or racing instincts.

The second direction is the development of a variety to suit a new environment: a mountain rye, a northern sheep. Both of these were traditionally accomplished through supporting *processes* (e.g. shortening the growth cycle of a rye plant, leading to a shorter stem and quicker seed formation; or encouraging early flowering and a long period of ripening the fruit, leading to the cultivated apple). In a cauliflower, the whole plant is actually adapted to support or encourage the flowering process, in contrast to an artificially overgrown flower blossom, where a single trait is overemphasized to an extent out of proportion to the whole plant.

In contrast, modern attempts to accomplish breeding have focussed less on processes and more on *traits* or *yield*: achieving a particular colour of flower, quantity of gluten or sugar, or toughness of skin (for ease of shipping e.g. tomatoes); or increasing the quantity of cotton produced by plant or milk given by a cow. This is an attempt to improve or cultivate an organism's *usefulness* by modifying its outer, physical characteristics. There is an enormous difference between seeking to strengthen an aspect of the plant's development, e.g. seeking to support the wheat plant's seed-formation processes, and seeking to increase the

physical yield, e.g. the sheer size of the seed-head. The latter approach, derived from the physical-mechanical world where outer forms are equatable with the inner reality, ignores the fact that it is the *quality* of the seed that gives it the capacity to nourish us, not the sheer quantity of physical matter. In living organisms, *processes* are real, whereas all outer forms are in a sense an illusion, being only the results of these processes.

We experience today that cereals, vegetables, fruits, milk, eggs and meat grown or nurtured by emphasizing quantifiable traits or yield tend to lose their quality; we get the tasteless tomato that can be shipped thousands of miles over several days and still stay firm and taut of skin, or the cow that falls prey to terrible diseases while giving record amounts of milk, etc.

The present day's attempts to produce new life forms by modifying individual traits are generally undertaken in order to create a variety, strain or breed capable of surviving and flourishing in a highly artificial environment, e.g. one including a high concentration of pesticides, or that the life-forms become resistant to the modern, imbalanced conditions of nature by themselves producing poisons, e.g. against moulds or caterpillars. The hope that these changes might be restricted to a single character trait, one the one hand, and that they will remain confined to the organisms directly modified, on the other hand, is the result of either hopeless delusion or flagrant dishonesty. As we have seen, processes, not traits, are stimulated by genes; any change will modify the whole organism, not remain local in nature. Research undertaken in Switzerland over the last few years, for example, has shown how the character of gene-modified potatoes is altered in a holistic, not merely isolated, trait-wise way, while there are increasing numbers of reports of the spread of modified genes from test fields or larger-scale plantings to plants in surrounding fields, in some cases over quite long distances. The web of life does not allow individual members of a species to develop independently of the others; this is the very definition of a species: the smallest community wherein free mutual exchange of genetic material takes place. A gene-modified organism will contribute its genetic material to the entire species' stock. At the same time, we now know that genes are shared, not only within species, but also between even distantly related kinds of organisms, to a far greater extent than was conceived of only a few years ago.

The original picture of genetic transmission was quite straightforward. Genetic information was inherited directly from the parent organism(s); except for the relatively infrequent case of mutation, this transmission was of intact, huge complexes of genes, or chromosomes. In the case of asexual reproduction, the daughter organism was supposed to have an identical genetic make-up to that of the mother; in sexual reproduction, the child was supposed to have inherited half of each parent's chromosome strands, and to have simply combined these into new chromosome pairs. In addition, Mendel's original research indicated that, for any genetically-inherited trait, one or the other of the inherited genes would be dominant over the other (as in brown eyes over blue), or else they would play an equal role (the crossing of red and white blossoming parents producing a pink-blossoming plant). The resulting organism would thus be a straightforward combination of the genetic characteristics of the parent organisms.

Further research showed that only certain traits followed such simple dominant/recessive patterns. Mendel happened to study rather simple cases. Most traits are not the result of such a simple combination of the parents' traits.

The decisive break with materialistic-deterministic genetic science came when it was discovered that chromosome pairs do not simply divide into their two halves, each half then

either duplicating itself to form the basis for a new nucleus, or remaining single in the case of the formation of gametes (sex cells). Instead, duplicating chromosomes exchange components rather freely, gene sequences sometimes moving about to a new location on the chromosome or even migrating to a new chromosome in the process. This implies that the genetic provision established by each parent (in a sexually reproducing organism), or even by the single parent (in asexual reproduction) is a potentially unique combination of the genetic traits available in the inherited sequences.

In addition, it has been discovered that alterations of genetic material take place much more frequently and systematically than was previously imagined, not just rarely and randomly. This is especially so during cell divisions, one special type of which leads to the haploid sex cell. In fact, it has been discovered that there are functions of the cell itself that specialize in providing such modifications, although to precisely what end has not always been able to be ascertained. Certain cells, for example, the lymphocytes, employ their own techniques to make and share specific kinds of purposeful modifications to their own cells' genetic code. This was the first indication that an organism may adapt its own genetic coding to suit its circumstances. There is considerable debate in the scientific community over whether such intentional modifications necessarily remain purely somatic in character, or whether they may be or are passed by way of the genetic stream to the organism's descendants. Mutation appears not merely to be the result of flaws in genetic transmission due to such factors as imperfect copying of sequences or accidental, chemical or radiation damage. Mutation can be driven from within the organism itself.

Finally, it has been discovered that direct genetic exchange between organisms (i.e. without the necessity of employing sexual reproduction) is a fundamental method of genetic transmission, at least in lower organisms. First it was discovered that viruses actually modify the genetic code of the cell that they enter, inserting their own code in its place; it has been estimated that 5-10% of human genetic material originated from such contributions from what are called 'retroviruses'. Then it was established that many bacteria actually are involved in a nearly constant interchange of genetic material. Sometimes this is accomplished by allowing genetic material to exit and enter the cell to and from the surrounding environment (bacteria are non-nucleated cells); sometimes there is a 'vector' or carrier involved, and sometimes direct contact between cells is required to mediate the exchange.

If lower organisms can exchange genetic material amongst themselves, and if they can also act as vectors that modify the genetic code of higher organisms, there is an enormous potential for systematic genetic sharing, transformation and evolution even amongst higher organisms. This is an area that is only just beginning to be explored. In any case, there is now good evidence that a significant part of the genetic code of most life-forms, and certainly of all higher organisms, has been accumulated as 'donations' from other organisms, and is not self-evolved.

The picture of genetic inheritance has thus shifted from a linear and mechanistic model of transmission and random mutation to include:

1) A process of selection of genetic traits from amongst the available inheritance that looks anything but random, and that includes the possibility of creating wholly new genetic patterns through re-orderings, doublings, shifts, etc.;

2) At least special cases of cells intentionally modifying their genetic code to adapt to their environmental conditions; and

3) Exchanges of genetic material between organisms as a method of speeding up genetic evolution (this has been identified, for example, as the source of the extraordinarily fast adaptation of bacteria to become resistant to antibiotics, stressful environments, etc.)

It is especially interesting that processes of self-modification of the genetic code have been found to be clearly present in the immune system, the part of the organism in which the ego is most strongly anchored.

The New Genetics

We are coming into a new consciousness of how nature modifies and selects genetic material at the same time that we are developing a new capacity to accomplish such modifications and selections ourselves. It must be asked in view of the survey of evolutionary aspects that opened this essay: What principles direct, influence or lie behind the natural processes of genetic exchange, transformation and rearrangement? Are these processes under the direct agency of a divine agency, or do they take place in a pre-ordained pattern, are they accomplished according to an innate evolutionary impulse or do they occur in response to evolutionary factors, or simply at random? Whatever our answer to this question, we must then ask ourselves: What will be the principles out of which *we* will undertake such modifications, transformations and selections? If the human being is now to take up an increasing role in directing nature's further evolutionary path, how can this be accomplished in a positive way, in harmony with the being and beings of nature itself, a way that will not destroy or ruin but rather maintain and enhance the course of evolution as it has been hitherto accomplished, and according to its further potential?

It is a challenging thought to many – including myself – that genetic alterations might be undertaken in this spirit. It might be observed, however, that there is a general tendency to accept relatively unquestioningly all those technological innovations with which one became familiar as a child, as well as by and large those which are mastered and employed on a regular basis as an adult. For my generation, the telephone and airplane are typical examples of this. Innovations which are first encountered in later life without entering into daily use are more usually viewed with suspicion as to their dangers for the future. This is by no means said to diminish the dangers posed by human manipulation of genetic structures. Not only are the potential consequences of such manipulation terrifying in the extreme, but it can safely be predicted that these manipulations will be frequently undertaken for reasons such as greed, ambition, fear, vanity, etc.

Nevertheless, at some point humanity must begin to take increasing responsibility for even this aspect of its own and the natural world's evolution. As we have seen, due to the destruction of natural habitats and healthy contexts for adaptive evolution, and perhaps due as well to the inherent limitations of purely adaptive processes to provide for evolution's further course even given a healthy natural environment, this point is rapidly coming upon us.

This raises serious questions: What would a responsible eugenics[6] be? The laws of heredity are being given into our hands, for good or for evil. It is up to us to ensure that it is for good.

[6] I am consciously and somewhat reluctantly using a word here that has fallen into disrepute due to its terrible misuse. By eugenics I mean here the human being's conscious influence on the genetic basis for

Methods

It could be said that, just as the organism has three primary ways of making use of genetic material, for growth, for metamorphosis and for replication, so modern science has developed three ways of making use of genetic substance: stem cell research, gene transfer and cloning.

Stem cell research explores a still not completely understood phenomenon: that the very first cells of the embryo of an organism – human embryonic cells are generally used – are still undifferentiated in nature. That is, whereas by about five days after conception the embryonic cells have already become irrevocably committed to forming a particular functional realm of the body – for example, nervous, muscular or connective tissue – in the very first few days after conception this is not yet the case.

During this initial stage, when the embryo consists of no more than about thirty cells, each of these cells still has the potential to take up any function in the organism. They may be rearranged, separated off and recombined in various ways and still result in a full organism.

Such cells are capable of propagating seemingly indefinitely, even *in vitro*: a stem cell separated off from the original clump will itself grow into a further clump of undifferentiated stem cells, which can then be separated and used to create further colonies. This process has become the source of huge numbers of such 'archetypal cell-beings'. Attempts are being made to tap the enormous flexibility and growth potential present at this early stage for various purposes, as well as to understand what enable these to be present in such cells and what causes their loss in the course of later development. Stem cells can be directed towards growing into organs, or at least organ tissue, of any kind, for example: hearts, pancreases, brains, etc. On the one hand, substances necessary to treat illnesses, such as insulin for diabetics, may be produced in this way; on the other, organs for eventual transplantation may be formed. (It should be mentioned in this context that there are actually certain cells in the adult as well that retain a partial ability to reorient and to become the seed form for new organ growth.)

An eventual Frankenstein, a made-to-order collection of individual organs, might be one day cultivated in this manner. The hope of scientists, however, is largely directed towards the potentially unlimited supply of organs for emergency and other transplants that this offers, as well as possibilities for circumventing the tissue rejection problem found with foreign donors; if an organ is grown out of a person's own mature stem cell material, the person would be able to donate themselves the organ required.

A second technique being explored today is that of gene transfer. We can now choose an organic process – say, that which makes a certain plant secrete a substance that inhibits fungal growth on its leaves –, isolate the gene for this and imbed this gene in the fairly simple and accessible structure of a retrovirus, which is capable of installing the genes it bears into the genetic code of the cells it invades. This virus is then allowed to infect a cell and replicate itself; the thus created vectors may be used to 'install' their genetic substance, including, but not limited to, the originally chosen gene into another organism – plant, animal

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evolution. I believe that it is inevitable that we will rapidly gain increasing power to exert such an influence, that this will certainly be made use of by one quarter or another, and am encouraging a responsible and humanitarian, as well as an environmentally sensitive and nature-friendly consciousness here. The phrase 'genetic engineering' is inadequate to this larger context; I have chosen a historically laden term instead, hoping to free this here from any association with its difficult past.

or human being – with the expectation that the gene will become active in the infected organism. In our example, the gene for fungal resistance would then lead the organism to secrete the inhibitory substance and gain a resistance to fungal growth similar to that of the organism from which the gene was originally taken; at least, that would be the aim and hope.

As we map the chromosomes of more and more organisms, discovering which areas and genes have an effect on the various anatomical structures, physiological processes, etc., there will be an increasing striving to make use of this understanding. Modifying a plant, animal or human embryo's genetic inheritance, whether in vitro or in vivo, either to overcome hereditary propensities (such as birth defects) or other undesired traits, or to implant desired traits, will become more and more common.

This raises a number of questions. The moral question as to who is to decide what is desirable or undesirable is huge. It must be answered out of a sense of responsibility to the incarnating being, whether this is a human being or an animal or plant. This presents challenges to each and every one of us involved in such decisions (and increasingly, whether as a consumer, a gardener, a voter, or a researcher, everyone will be and in many cases already is involved in making such decisions). There are also significant scientific questions, however.

An organism is not the mere sum of its traits. When new genetic substances are implanted, the *whole* organism is affected. We recall that genetics determines processes, not traits; the traits are the result of these processes. Any organic process affects more than just a single trait, however, and thus no genetic modification remains isolated in its effects. The result of adding, removing or modifying any portion of the genetic substance, it is now being recognized, necessarily has unforeseen consequences for the rest of the organism beyond the particular goal motivating the change.

In addition, a gene may have certain effects when it appears in one organism, and completely different effects when it appears in another organism! Craig Holdrege gives the example of what is thought to be the nitrogen-fixing gene in nitrogen fixing plants, which also appears in ……! Even the immediate function of a gene is determined by the whole context of an organism, just as its expression will affect this whole context.

Nevertheless, it must be emphasized that gene transfer is one of the central techniques that nature has used to build up our genetic substance. It has been estimated that 5-10% of the human genome, for example, is composed of components received from retroviruses. What of this is harmful (there are genetically transmitted illnesses or defects that are known to have originated from retrovirus infection, for example one type of muscular dystrophy), what beneficent, and what neutral is not yet established, but it is clear that gene transfer is completely 'natural'; though we use it in other ways than nature does, it is one of nature's favorite techniques to achieve genetic evolution.

Synergy

Almost from the very beginning of the focus on adaptive evolution, the physical carrier for inheritance has been of great interest to researchers. Progress in discovering the mechanism for preserving as well as allowing for variability in individual traits began with Gregor Mendel's experiments with plant cross-fertilization. We now identify the chromosomes and genes as the physical carriers of the inheritance of individual traits.

Science still cannot clearly and definitely describe the actual process by which organisms' genetic expressions undergo variation. It was long held that randomly occurring mutation of genetic traits alone could stimulate sufficient variation of a species for organisms to adapt to new environments. This is now being questioned. Laboratory attempts to accelerate random mutations do not generally result in an increase of stable and healthy adaptive mutations, but in the degradation of the species. In addition, under controlled conditions the adaptive evolution of traits (of bacteria in a hostile environment, for example) seems to occur faster than random mutation and natural selection would allow for. Part of the contemporary crisis in medical care is due to the capacity of disease organisms to rapidly and unexpectedly evolve new strains either where a disease was apparently effectively eradicated or in response to the widespread application of antibiotics.

We now know a great deal about the range of life forms inhabiting the earth. Our knowledge extends not only over centuries or millennia, but – through fossil records – over millions or even billions (thousands of millions) of years. In addition, a vast number of experiments have been done to induce adaptive variation of organisms in laboratory conditions. It is difficult to find historical evidence of clear transitions to truly new species – much less to a new genus, family, order or higher division – developing through gradual and continuous steps, whether adaptive or otherwise. The only 'species' that have been observed or shown to arise through any sort of continuous evolution are regionally distinct sub-groups of an existing species gradually losing their ability to breed with the rest of the original species. The characteristic that defines these as a new species is their *loss* of the capacity to interbreed with the other members of their original species. The increase in specialization and decrease in generalized, adaptive capacity that characterize such evolutionary paths make the resulting genetically distinct sub-species appear to be evolutionary terminal points, rather than steps on the way to further evolutionary developments. The famous 'missing link' between the ancestors of the great apes and our own, human ancestors is not an exception in this respect. There is a missing link, an inexplicable evolutionary leap, between *every* species of life and its supposed predecessors. It seems increasingly plausible that living organisms do not exist in an evolutionary continuity.

What could explain such leaps in evolution? If genetic mutation is the sole mechanism for evolutionary progress, then evolution will be gradual and accumulative rather than radical.

What if, however, nature's collaborative working reaches even deeper than we initially suspected? – If organisms not only support each other in a kind of mutual help network, such as we see with the nitrogen-fixing bacteria that live on root nodes, or in lichen, but even offer each other the result of their genetic 'research', the products of their evolutionary progress? What if, having evolved a capacity to produce energy from light, bacteria could share this capacity with other living creatures?

Adaptive evolution has traditionally emphasized the environment's role in shaping living organisms. In fact, organisms have a reciprocal and equally significant effect on the environment. The change in the atmosphere's constitution from an ammonia/methane/carbon-dioxide mix to a nitrogen/oxygen mix was not only a stimulant to the development of a whole new range of oxygen-breathing organisms. It was also the result of earlier developing organisms' activity: the cyanobacteria and, later, green plants. The earth's environment and the life that lives in that environment have evolved parallel to one another in a process of mutual co-adaptation.

There is another weakness to the theory of slow adaptive evolution. If it were a valid and exclusive model of how nature's organisms arise and evolve, organisms that arose at periods when the environment was radically different than at present would presently be under the greatest environmental pressure to continue to evolve, whereas more recently evolved organisms, which arose in an environment closely paralleling their present one, would be under the least environmental pressure to evolve. This is the opposite of what we observe in nature, however. Throughout evolutionary history, ancient types tend to evolve least – generally being tremendously stable – whereas the most recently evolved types of life forms tend to rapidly evolve into yet new productions. There appears to be an overall evolutionary direction or thrust; those life-forms at the 'growing-point' of evolutionary progress tend to continue to evolve most rapidly, whereas those left behind tend to rigidify into fixed forms (or become extinct). In this respect, the 'tree of life' grows like any of nature's trees: not just passively adapting, but with clear aim and purpose. Its form, like that of other trees, seems to transcend its genetic explanation.

This leads us back to the question of the origin of evolutionary direction: is this innate in the living world's nature or transcendent to it, directed from within or without? According to Goethe, all that is potential in nature manifests outwardly in one or another of her forms. The potential and the appearance are a dynamic unity. We could go beyond this to suggest that the outer evidence or revelation of her evolution, her inner, directive impulse and the transcendent, higher agency that guides her and in whose service all life unfolds are a trinity-in-unity, three aspects of a single underlying reality. Life could no more unfold its directed impulse without this being the result of a transcendent being than it could manifest an outward expression without this being the result of an inner process.