

## BEAUTY AND THE ANIMA MUNDI

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When we consider the contemporary natural and human sciences as a whole, what emerges is a remarkable vision of the universe and its history. This vision will, I believe, serve the same function with respect to twenty-first century humanity that the great chain of being did for the high middle ages and the renaissance : a way of connecting cosmos and psyche, of ascertaining and generating value, and of guiding creative action and innovation. The terrible events of this century have, I believe, left a sufficient residue of poisons in our intellectual and artistic culture — despair, denial, and distortion — so that this new vision will have a very difficult time coming into the world. But it is the only one which now offers any intellectual space for play, for a loving acceptance of ourselves and of the rest of nature, for creative research, and for really new art, and so I believe that the human imagination and the “holiness of the heart’s affections” will not long be able to resist its temptations.

Though the comparison with the Great Chain of Being is a valid one in some ways, there are immense differences between the emerging new synthesis and the old. First, and most important, the new synthesis is essentially dynamic, changing, evolutionary, historical, and irreversible, while the old was static, unchanging, creationist, eternal, and cyclic in its temporal manifestation. In the new synthesis (which we might as well call the evolutionary synthesis) new realities — new species, for instance — can emerge, whereas in the old Aristotelian-Thomistic system species, or kinds of things living or unliving, are eternal categories, which their temporal exemplars or avatars in the material world strive without full success to fulfil and accomplish.

The second major difference is that the old synthesis works through a fundamentally top-down causality and ordering process, whereas the new

synthesis, at least in its early stages, is largely bottom-up in its causality and ordering. In the Thomist universe God created and ruled the angels and human beings, who themselves ruled over the animals, which in turn were given domain over the plants, which controlled their inanimate material food, and so on down. In the evolutionary universe the sequence is reversed : the laws and the particles of physics largely determine the ground-rules of chemistry, which provides the arena for life, which in turn produces and generates conscious minds.

Of course in the Thomist universe things did not necessarily go according to the ideal pattern, because of free will, the differences between matter and spirit, and the disordered attempt of lower organisms to usurp a higher place. And in the new synthesis, bottom-up material determinism, operating through the variative/selective process of evolution, paradoxically brings about organisms which, as wholes, determine themselves and their inner and outer environment as much as or more than they are themselves determined. Thus in the new synthesis a top-down, whole-to-part creative ordering can exist, though it must first be brought into the world, and must continually be maintained, by a bottom-up, part-to-whole evolutionary or metabolic process. Together, then, in the evolved state of the world, bottom-up and top-down causality cooperate in a complex feedback system which is capable of further self-elaboration into yet more reflexive states of being.

The last major difference between the old Great Chain of Being and the new evolutionary universe is that whereas the former requires an outside creator and arranger, the former is self-creating and self-organizing. The old worldview provides an eternal transcendent God radically separated and distinguished from His creations by the fact that He alone is self-sufficient and self-creating. The new view, on the other hand, is approaching the position that the universe is a logical necessity; that is, the existence of a state of affairs in which nothing at all existed would require some extraordinary, ineffable and transcendent metaphysical intervention; but the existence of an evolving, self-organizing universe is essentially inevitable without such an intervention.

This view places the characteristics of loving fruitfulness, the apparent intention of design, and teleology, once postulated as necessarily belonging to the creator, in the creation itself, if they are anywhere at all. Until a couple of decades ago it was assumed that the physical universe works deterministically, and so if we accepted the new view we were

forced to assume that those “creatorly” characteristics were nonexistent, illusions imposed upon a blind and automatic universe by our animistic expectations. In other words our intellectual honesty required us to disbelieve our eyes and ears, which told us of the joy of creation as it sings itself into being. But now the new mathematics, physics, and chemistry of non-linear non-deterministic dynamical systems show us that the physical universe is, in effect, free, and can thus be held responsible for its own beautiful order, or richness, and creative innovation.

There is an apparent contradiction between the idea that the universe *had* to come into existence, and that it is free. But this contradiction is only apparent. *Some* kind of evolving, self-organizing universe is a necessity; but which one it is, how it evolves, which direction it takes are, so to speak, up to its own choice. And “choice” is really not a bad word at all to describe the way in which, as the new science has shown, complex and unstable dynamical systems, on the verge of some transformation and unable to hold their present arrangement intact (for instance, a hot but cooling universe of pure energy about to give birth to matter, or a supersaturated crystalline solution, or an ecosystem with more resources at its disposal than it is using, or a heart between beats), unpredictably “collapse” into one of a large number of possible new states. The collapse is unpredictable not necessarily because any of its contributing elements is disordered but because all of them are on each other in a complex contextual feedback relationship, and must thus all change together, without a causal priority and sequence that can be analysed by any system smaller than the universe itself. The fact that this state will fall within the parameters of a very beautiful and elaborate “strange attractor”, and not outside it, is an indication not of the *lack* of “choice” in this sense, but of its orderly coherency, its nonrandomness.

The current evolutionary vision of the world, which, now that we have qualified the meaning of the phrase, we might call the new “great chain of being” needs a brief general summary here. Scientists, who for the most part are at work upon some small section of it, often do not pay much attention to the shape of the whole; though there are exceptions, such as Roger Penrose, Roald Hoffman, J.T. Fraser, Stephen Hawking, Paul Davies, John Archibald Wheeler, Lynn Margulis, Roger Sperry and George Seielstadt, among others. Scholars in the humanities often have an idea of science based more upon the philosophy of science than on contemporary developments in science itself, a philosophy in turn based

upon or critiquing scientific ideas that are over a half a century old.

Large areas of the new vision are still under vigorous debate; for instance, many environmental and ecological scientists are inclined, because of the synchronic and synergetic nature of their subject, to ignore or deny the differences in level of anatomical and functional development between species, and interpret the interdependence of different species as equality. Evolutionary biologists, anatomists, organ specialists, ethologists and neuroscientists, on the other hand, are usually so close to the miraculous specializations and hierarchy of biological function in the organisms they study, and to the evolutionary history through which the less organized developed into the more organized, that the terms "higher functions", "higher organisms", "more advanced species", and so on are fundamental to their work and implicit in the nature of things. For the former, a virus or bacterium is in theory just as valuable as a mammal, even as a human being. For the latter, the greater complexity of higher organisms makes them more interesting, more wonderful, and more important to preserve than their less-evolved kin, though even the lowest living organism is a miracle compared with a piece of non-living matter.

Nevertheless such debates, except where exacerbated by ideological hatred and political manipulation within an ignorant public domain, are capable of resolution through a more sophisticated consideration of different perspectives. Certainly for the purposes of a forest ecologist, a virus, which may only be a tiny clipping of RNA with no metabolic machinery of its own, that must parasitize the cellular infrastructure of some plant's leaf to exist at all, may be just as crucial a part of an ecosystem as an oak or a moose (or a human tribeswoman). Meanwhile, for a paleobiologist or cytobiologist such a virus would be only a living fossil of an age of biological complexity infinitely more primitive than that of the moose's least muscle cell, whose smallest gene would be more subtle in operation and function. We see things differently with a microscope than with a telescope.

But the two viewpoints are not irreconcilable; in fact they are complementary results of a self-consistent whole, given the biologically-based mental system in which we generalise, symbolize, compress and push down to a lower level of attention any information which we receive — ironically, a hierarchizing process in itself. Moreover, both the ecologist and the evolutionary biologist would recognize a difference in complexity and organization between a live organism and a dead one, and would be

much less interested in the latter. A chemist or physicist might prefer to work with non-living matter and resent the pro-life prejudices of the biologists. So the argument is not one which denies relative value, but differs, because of professional perspective, on where it should be laid.

Given these qualifications, what does our new great chain of being look like? The most exciting mathematical ideas of our century deal with the incompleteness and open-endedness of any mathematical system, and its propensity to generate paradoxes which can only be resolved in terms of some richer and more reflexive system which includes it — a system which must in turn contain its own paradoxes, and so on. These relationships, of inclusion, containment, open-endedness, incompleteness, extension, “between-ness”, and even, as the case of the orientation of the imaginary number series with respect to the real numbers, orthogonality and thus angles — immediately suggest spacelike dimensions. The discipline of topology may be defined as a demonstration that space, spatial dimensionality, is the only solution to certain problems in mathematical logic. Space is the way that true statements which would contradict each other if they were in the same place, space themselves out from each other. The Pauli exclusion principle which states that two identical particles cannot occupy the same energy-state at the same place and time, is a physical example of this idea. If the two particles were in the same place, they would be both two and one, which violates the non-contradiction law of logic. In other words, a non-spatial world, if everything thinkable within it is to remain logically consistent, must necessarily generate a spatial world.

The new fractal geometry includes a working concept of how a given dimension can be generated, and coherent definitions of partial dimensions. We are familiar in classical geometry with zero-dimensional points, one-dimensional lines, two-dimensional planes, three-dimensional volumes, and so on; popular science has invited us to imagine more dimensions still. But the non-integer dimensions of fractal mathematics — a given curve can have a dimensionality of 1.62, for instance — are a new concept, and show us how we might, through the feedback of an iterative algorithm, actually get from one integer decision to another.

Certain other problems in mathematics involve the relative easiness or difficulty of a calculation. Some calculations wind themselves up without complication. Others involve more and more sub-calculations, and sub-sub calculations, before the calculator can produce an answer. In order

to be able to talk coherently about such distinctions, and to measure their differences, another kind of dimensionality is needed : time. In its simplest form time is to the three spatial dimensions what the imaginary number series — the square roots of the negative numbers — is to the real number series. Time gives us a dimension within which we can describe the difficulty of a calculation, whether it is soluble in an amount to time that increases polynomially with the number of variables in it, or exponentially, or more swiftly still, or infinitely; and if infinitely, which of Cantor's larger and larger infinities it would be.

Thus spacetime emerges out of very logic; and given spacetime, theoretical and cosmological physics can show the necessity of the Big Bang, of the emergence of energy as the coherent solution of certain possible and necessary spacetime geometrical paradoxes, and of the self-binding collapse of energy into matter as the universe cools with its expansion. Matter is the solution to paradoxes that arise in the energy universe as the primal superforce separated itself out into gravitation, electromagnetism, the weak and the strong nuclear forces.

We might add that not every possible kind of energy and matter does emerge, and once having emerged, survive; there are apparently no magnetic monopoles, though there could have been; and there is very little antimatter, since at the point of the collapse into matter, physical laws demanded that the energy universe choose one or the other but not both for its debut into materiality. Many possible isotopes do not exist because the conditions of their survival are not present. Thus a peculiar primitive kind of "choice" already existed at the very beginning of things. Various exotic kinds of matter emerged — we can reproduce their emergence sometimes in an accelerator — but were selected against by the existing ecology of the physical world, and did not survive for long. Tough objects like protons and neutrons, or intangible ones like neutrinos, can survive a great deal of wear and tear, and so they are long-lived and plentiful, as are certain elements, like hydrogen and iron, and certain molecules and crystalline structures in cooler and quieter environments.

Given matter, another open-ended process begins, of chemical recombination. Here again we find a process of variation, in which the vicissitudes of a rather violent universe thrust together arbitrary combinations of chemical elements, and in turn test them to destruction, leaving the survivors to survive. But in chemistry those survivors can only endure, or at best grow by accumulation, as crystals do. They cannot avoid, adapt

to or anticipate the threats of a dangerous universe. Nor, if they are especially successful at weathering or dodging the dangers, can they copy themselves so as to improve their statistical chances; yet the logic of survival in time would demand that they should. Their potentially successful form is held hostage to a particular local piece of matter, if the form could be copied to other matter, then the form might survive the enemies of matter — heat, mechanical destruction, chemical corrosion. And so yet another solution to an existing paradox emerges — life.

With life a new element enters into the iterative variation/selection algorithm by which evolution had proceeded: heredity. Life has, as it were, a double life; as matter, and as a recorded copy of the form of that matter. It is more reflexive, more conscious, so to speak, than matter by itself. (Of course, as we have seen, matter is itself “double” with respect to its substance, energy: it is energy, but also a self-maintaining field structure containing the energy. And energy is “double” with respect to the spacetime field, and the spacetime field “double” with respect to mathematical logic.) Life not only evolved in a new way, by self-copying; it also developed in turn new forms of evolution. One of the most remarkable of these is sexual reproduction, which, instead of merely accepting mutation as part of the damage of existence, actively anticipated and promoted it by sexual recombination.

Now the biosphere took increasing control over the nonliving substrate of the planet Earth, radically altering the composition of its air, regulating its climate, setting up complex chemical cycles throughout its atmosphere, hydrosphere, crust and perhaps even its mantle. It is thus entirely natural for an emergent and more reflexive kind of order to control and subordinate the earlier and more primitive forms out of which it evolved.

Here there is a subtlety that escapes some evolutionary biologists, who instinctively distrust any suggestions of teleology in evolution. The point is this: if the genome and nervous system of a given species are sufficiently complex to support teleology and teleological motivations (even if very rudimentary ones, such as care of the young), and if a hypothetical species is more adaptive, and survives and reproduces more successfully, when it acts as if it possessed teleological goals, the variation could bring about such a species, and once it did, selection could help it to spread. In order to compete with such a species, other species would

need to develop the same talent, of acting (and thus being motivated to act) as if there were teleological goals. (In just such a fashion the indicative mood of the real number series demands and implies the subjunctive mood of the imaginary number series.) After a rather brief interval of evolutionary history it would be very hard to tell whether one were living in a teleological universe, striving to become more advanced and sensitive and self-aware and concerned with the future, or whether the world around one were simply acting as if this were the case. And for a scientist such a difference should really be of no concern, though it might be distressing to a philosopher.

But as the competitive-cooperative ecology of the living world became more and more complex, and improved forms of biological evolution accelerated the rate of speciation and ecological change, the Darwinian mechanism of biological evolution began to reach its speed limit. It takes at least a hundred thousand years for a species to develop a new capacity in response to its experience in the environment; and the whole species, or most of it, must go through that experience in order for the selective process to work. Would it not be better if something like Lamarckian evolution were to supplement Darwinian evolution? — an adaptive process which could make appreciable changes in one generation, which could use the experience of individuals rather than that of the gene-pool as a whole? Would not evolution be still more efficient if alternative scenarios for the future could be tried out in a virtual world where they could do no damage, before they were actually embarked on? Would it not be better to supplement the very slow genetic diffusion of information through the species, with faster forms of communication independent of the reproductive process? Might not new forms of information storage be developed, above and beyond the genes, which would be to the genes what the genes were to the matter of which their bodies were made or as the structure of matter is to the energy it binds?

The answer to these questions was, of course, the human species: its traditional rather than genetic way of mutating the radical store of information, its brain, its memory, its language, its cultural institutions, its imagination. Again, this new emergence was the solution to paradoxes implicit in the nature of the universe that preceded it. Survival, now revised and enlarged in definition beyond reproductive success to control and prediction of the biosphere itself, and to a richer existence within many possible time-lines, required a faster acceleration of the adaptive

process than biogenetic evolution could provide. Humanity is the solution to the paradoxes of life, as life was for matter, as spacetime was for mathematical logic.

Of course, the irony of this process is that the paradoxes get more complex with each new solution of them; and the human paradoxes, which I would sum up in the word "shame", are the most pressing and difficult of all, especially as, unlike their predecessors, they have not yet been solved. Those thinkers who have in despair, or in denial of shame, or in fashionable cynicism, condemned the human species and its progress, have not reflected that in a sense the shame of things goes all the way back : the shame is most primitively the paradox of self-inclusion. If they would turn back the clock and abolish humankind (for this is the only viable conclusion to their arguments), they would be cutting off the very process of existential tension by which the universe came to be. But cannot we think differently of the unsolved human paradox? — as the open-endedness of the universe, as its evolutionary potential, as its great hope, as our chance to prove our creativity, as our solidarity with the whole cosmos in its great questioning expansion and fall, outwards into richer, more anxious, more complex, and more beautiful forms of being?

Value evolved slowly in the universe, increasing with each access of reflexivity and level of feedback, complex entities conferring value upon each other and upon the less complex by sensitively registering their presence, perceiving, eating, mating with, desiring, or loving them; and conferring value upon themselves by their increasingly intentional and planned attempts to survive and reproduce. More intense and more universal values evolved with increasing ecological interdependence, whether among whole populations of species or in those fantastically complex and swiftly-evolving inner ecologies, the nervous systems of higher animals.

Between the collapse of the old great chain of being and the rise of the new there fell a period in which no coherent intellectual structure existed for assigning to things the value we instinctively know they hold. (Give the most egalitarian environmentalist the choice between sacrificing a dog and sacrificing a cabbage — or a rock — or between having for medical reasons to lose an arm or the brain, or between a chosen lifestyle and the life of a fetus, and a very clear value hierarchy emerges.) Nevertheless for some time that "common-sense" value system has had no rational defense, and thus our basic moral habits have been in danger of suppression by reasoned callousness. In many modern systems — Nazism, Com-

munism, and more recently radical environmentalism or Deep Ecology — we were invited to believe that a human being was less valuable than the state, the working class, or the lives of animals and plants. In some cases the language of morality itself was used to attack our moral common-sense : SS officers who collapsed under the strain of the atrocities they were expected to commit were rallied by an appeal to their moral objectivity.

Some radical environmentalists today make much the same sort of argument, asserting for instance that it is only our self-centered and traditional partiality that makes us value the lives of human beings over the lives of cockroaches, trees or plankton. According to this view, it would be a crime to kill a billion bacteria or AIDS viruses to save a mere human life. Murder could be redefined as the harmless transformation of a human life into a rich ecology of bacteria and invertebrates. But why stop here : does not a dead rock have just as much right to exist as a living organism? Dead rocks were here before life was, after all, and have been proven Natural by their long survival : would it not be moral, then, to cleanse the Earth, by a nuclear holocaust, of all life together, giving the planet back to the physico-chemical ecology that possessed it before we, the disease of life, broke out on it?

Though the social and economic changes that destroyed the old value-giving rituals were the main cause of this crisis of value, part of the credit must go, paradoxically, to the very success of the physical sciences, which, as we can see clearly in the *Novum Organon* of Bacon, had at their outset to fight for their very existence against rigid traditional codes of value. Science adopted a “value-free” ethic which worked very well for the investigation of very elementary and ancient objects in the world, but which was increasingly distorting when it came to biological and cultural entities. Science has, as we have seen, moved on from this initial prejudice; but the damage has been done. It is still intellectually respectable to deny any or all of the values of one’s own culture, of civilization, of the human race itself.

In the absence of an objective way of determining value, we were left with four alternatives : to make value purely subjective (“reader-response” theory), to determine it by money and votes (Hollywood, consumer research, and the National Endowments), to make it identical with coercive political power (Foucauldian discourse analysis), or to deny its existence altogether (Deconstruction). It is the various combinations and

conflicts of these alternatives that have made up the texture of public life in the last half-century. But I believe this period is now coming to an end, and that we may have a chance to redeem the destruction of an old and productive, if flawed, value-system, by the introduction of a new one that has corrected the errors of its predecessor and learnt from the atrocities of the interregnum. The newly liberated countries of Eastern Europe may help to show the way; under their commissars they were subjected to a double dose of the cynicism we absorbed in a milder form from our own academic and bureaucratic grand inquisitors; less bribed by material and economic comforts, they may be more on their guard against it.

At the core of the new value-system that is emerging is beauty. The capacity which our extraordinary self-evolution as a species sharpened, accelerated and deepened was the ability to recognize and join in the creation of beauty. Beauty is the creative principle of the universe, the feedback process that generates an ordered world with a chaotic boundary in time. That boundary is the present moment, the culmination of the past and the source of the future; as it expands it generates broader and broader degrees of freedom, freedoms only possible and only articulable in terms of the greater intricacy of the new forms of order that are generated there. Its expansion is made possible through the existence of contradictions or paradoxes within it, and our human experience of these is of shame, tragedy, and death.

When we perceive this process at work in nature we are rewarded for the insight by the pleasure of beauty, and can harmonize ourselves with it and join it in creative activity, using our evolved neurocharms as the link between the constructive energies of nature and our own more reflexive and swifter forms of creative feedback. The complex, self-similar, fractal, paisleylike and organic forms, the complex melodies, that we find immediately attractive, are a sort of logo or epitome of the deeper and stranger, more multileveled and heterarchical systems which they foreshadow and subtend. The branchiness and inner articulation that such forms possess is a sign of the branchiness of the free processes that brought them about and the historical reflexivity that they embody. We see them everywhere in nature, in the whorls of galaxies, in the exquisite forms of crystals, in water-currents and sea-foam, in tree-branches and ferns and flowers, in the movements and ornamentation of animals, in Maori tattoos and Haida totem-poles and Hokusai clouds and the imagery of *A Midsummer Night's Dream*; in Lorrain landscapes and the musical

organization of Mozart's *Magic Flute* and the fantastic hierarchy of the laws of science. Most beautiful of all, perhaps, is the brain-process of a human being that can experience these things; and that process is itself evolutionary, branchy, internally articulated, multileveled and heterarchical.

If beauty is as it is described here, it must also be, as Keats said, the fundamental source and hallmark of truth. If truth is conformity to fact, and fact is the product of a feedback process which we intuitively perceive as beauty, then beauty is the way we perceive and intuit truth. This formulation is nicely confirmed by the history of science : it is quite clear that of the infinite number of hypotheses that will coherently explain a given body of observational and experimental evidence, scientists instinctively choose the one which they find most beautiful or elegant. The power, economy, generality, richness, productiveness, and challenge that scientists admire in a theory are exactly the characteristics we see in the product and process of the universe's evolutionary feedback system : hierarchy, open-endedness, branchiness, self-similarity, reflexivity, mutual actualization and interdependence, fertile paradox, and so on.

And theories with these characteristics do tend to be true; so much so sometimes that scientists will remain faithful to them for long periods against the apparent evidence. They are so beautiful they *have* to be true. And in the cases where they really are not true, which we might compare to optical illusions, the true theory turns out to be even more beautiful, and the attractive qualities of the disproved theory often turn up elsewhere in nature. For instance, the crystalline spheres and harmonic properties of the Ptolemaic macrocosm, though replaced by the still more elegant system of Copernicus, Kepler and Newton, return in a strange way in the harmonic and quantized electron shells of the atom. Sometimes even, our great cultural symbols are intuitive apprehensions of the actual shapes of fundamental natural systems and processes : the snake-entwined rod, the metatron of Moses, the double helix caduceus of Hermes, the twisted body-helix of the Hindu chakras, is an anticipation of the form of the DNA molecule.

Two possible objections arise. One is the fashionable idea that there is no progress in science but only a succession of sociologically-determined paradigms, and that the idea of truth is thus meaningless. The second is more interesting : if everything is the product of a beautiful and beauty-making process, what is the point of the distinction between the beautiful

and the true, and what is the status of the ugly and the merely plain and unbeautiful?

The first objection disappears with the application of a little simple logic and intelligence. There is an asymmetry between an earlier “paradigm” and a later one, which is that one is earlier, the other later, and thus the earlier one can be known to the later one, though the later one cannot be known to the earlier one. Thus the later one has at least the opportunity to include the ideas, perspectives and canons of proof of the earlier, even if in a role subordinate to a reflective criticism, while the earlier cannot do so with the later. So genuine progress — which, in science, cannot mean anything other than a closer and deeper approach to the truth — must be going on; at least there is no lack of an opportunity for it to do so.

If it be further objected that the later is incapable of imaginatively entering or seeing the world through the eyes of the earlier, then the same stricture must apply to the historian or philosopher of science, who claims that incommensurable worldviews succeed one another; how does he or she achieve the miracle of hermeneutic boundary-crossing, while the scientist cannot? And if the historian or philosopher cannot cross the boundary into another paradigm, how does he or she know that it is different from and incommensurate with this one? Worse still, suppose this wise philosopher’s views on the paradigms were to prevail: must not this be in his or her terms a step in the right direction, in other words, intellectual progress? Suppose the scientists adopted it? Would this new paradigm again be incommensurable with their former one? — if it is, then the theory must be false. It is a sign that very powerful emotional forces of denial must be at work, when intelligent people can accept the kind of nonsense preached by some contemporary critics of science.

The more serious objection, that the view of beauty proposed here breaks down possible useful distinctions between the true and the beautiful, and between the beautiful, the ugly, and the plain, requires a reconsideration of the historical, evolutionary, and hierarchical aspects of the model. All of these distinctions can be kept, but in a new framework. In the evolutionary self-creation of the universe there are clear distinctions between producers, processes, and products (though any entity may be two or three of these at one). The true applies to all three, together or apart, but the beautiful applies to the continuation of the *process* of creation especially, and to the others only as conditions or signs of it.

That is, a product of a beautiful process may be relatively plain in itself, even if it suggests the beauty of its creation. And the producer of a beautiful process, like the stem of a plant, may also be relatively plain in comparison to its glorious flower.

Moreover the joyful productiveness of the universe could very well generate a choking mass of dead product, or inferior or retrograde or destructive subprocesses, parodic reductions of the creative drive, that could resist, turn back, or even damage in places the beauty-making process : and here we find the ugly (and so the evil). Indeed, we have here a possible rationale for those who fear the Promethean destructiveness of the human race, and a source of valuable caution and criticism. But the answer is not to try to stop the creative process, but to heighten our self-referential and conscious powers of selectiveness, and use them to supplement that old, blind, ruthless, but now too slow process of natural selection. And if we are to take these powers upon us we must be prepared to accept the terrible shame of our evolution and survivorhood, the very shame that led us to deny beauty, the creative process, in the first place. And finally the only means we have for recognizing the difference between creative evolution and its destructive parodies is the sense of beauty itself. Perhaps we might suggest that the creative forces outweigh the destructive by the ratio .618... to .381 ... !

And there is even a mysterious place for the enemies, cosmic or human, of beauty. They are what can force the leap to a higher order of reflection, a new dispensation of more concrete being. This was the special insight of John Milton in *Paradise Lost*, though one finds it in various forms throughout human myth, story, and literature — the *Mahabharata* is a good example. The evolutionary drama is not a monologue (though it is not either, *pace* the pluralists, a scatter of mutually-unheard voices bombinating in the void). It is a drama, a conversation, in which the participants are competing, but competing partly over the best strategies of cooperation and love; and cooperating, even when that cooperation sometimes consists in the noble adversaryhood of dialectical opposition. The nature of the drama itself is under contestation and collaborative construction, though its existence and the need to acknowledge the story up to now are established as a consequence of the asymmetry of time. And there is both the possibility, and the agreement, that the participants can be changed, perhaps profoundly, by each other. The deepest ugliness is not being in the wrong but denying the drama, the game, itself; taking

one's ball and going home.

Beauty, in the sense given here, is at the core of our cognitive abilities; it is also at the core of our moral conscience. What is the goodness? If we paraphrase and interpret slightly a saying of Jesus of Nazareth, it was to love oneself, to love one's neighbor (now rightly expanded to cover all beings and things) and to love above all the creative principle of the universe as a whole. Obviously one should not love everything equally. Other things being equal, we should clearly love an animal more than a rock or a styrofoam cup, and a human being more than an animal; and there are some things one should not love at all in themselves, like Nazi gaz-chambres (though one should in fairness love the innocent workmanship of the bricks, the crystalline structure of the iron). What, then, should determine how much, and whether, one should love something or someone?

There are two possible answers to this question. One is that one should love whatever is powerful, and the other is that one should love whatever is beautiful. Under the former we might include the instruments of political or economic coercion; and thus moral history could be defined as the competition between the love and the coercing group for their own coercive power, and the desire of the coerced to coerce. Power, as we have already pointed out, consists in the ability to set in motion a linear and deterministic cause-effect sequence, in which oneself is the cause, and there is as little as possible in the effect that does not derive from oneself. Thus true power results in a sequence of events in which the later state is always lesser in complexity and potential change than the earlier, because if there is something in the later state which is not derived from the earlier, then something would have escaped the determinative process. In other words, power is like a syllogism : if its conclusion contains something not in the premisses, the syllogism is false. But if the object of powerful coercion were to be transformed by it into something identical to the powerful coercer, it would become a rival. Thus the transformation wrought by power must always reduce its object to something lesser than itself. And so a universe of power would, however complex, structured, and rich its beginning, steadily ratchet itself down into an unchanging state of simple impoverished chaos, having paradoxically stripped itself of determinative power through its very exercise; it would deconstruct itself.

As we have seen, this is the exact opposite of the way in which the

universe actually articulated itself into richer and richer states of complex freedom, bringing about those intricate organisms such as plants and animals and persons which we should love. Thus it cannot be power for which one loves things and people, but beauty. One might say that beauty may be a power; but that power is a paradoxical giving-over of determinativeness to the others, to the future, to one's offspring, to the fruit of one's process, so that new things can arise that we did not intend. But this is a different use of the word. In its normal use power is the opposite of beauty, and as beauty is what it is good to love, then power is what it is evil to love.

Some thinkers have in recent years questioned the relationship between the beautiful and the good, using the striking image of the concentration camp commandant who goes home after a day's work exterminating people and listens to Beethoven on the gramophone. I find this unconvincing as an argument, though perhaps, as an exception, a useful reminder of the dangers of compartmentalization and specialization. It would, I think, be fair to say that lovers of beauty throughout the world generally opposed Hitler, with but few exceptions, and that despisers of beauty would have had nothing to object to the Nazi ideology. Most Nazis, I am told by my friends who survived the Holocaust, were thugs and vandals, insensitive to the arts. But the image of the music-appreciating commandant in his smoking-jacket has been taken to mean that the love of beauty is no protection against evil, and may even be a kind of evil, a feverish sort of disease, in itself. This image has behind it another implication still, which is that it is permissible for one of the esthetically elect to venture into the realm of evil, boldly and self-sacrificingly exposing him or herself to the darkness and infection in pursuit of his or her art. This idea is both mischievous and silly, and invites a strict logical refutation. Let us compare the commandant's moral to his physical health. If his lungs, ribs, brain and lymph-nodes, say, are horribly infected with tuberculosis, as his mind is infected with Nazi ideology, the relative health of his heart and limbs, like his love of Beethoven, should not be held to blame. Worse still, we should not in generally healthy people attempt to damage the heart and limbs in the belief that we are thereby staving off tuberculosis. And yet the attack on the love of beauty has followed much the same pseudologic.

If beauty and goodness, despite such attempts at mischief, are not detachable, what *is* the difference between beauty and goodness? It is,

perhaps, something like the difference between a pull and a push. Beauty is an attractor; goodness is a duty. Goodness is the faith and will that puts us in the way of grace; but beauty is gratis, is the grace itself, gratuitous, unwilled, in an anguished but delicious near-communion with the whole of the universe. Goodness operates by policies, commandments, principles, conscientiously seeking the best angle and most economical path to catch the spirit in its flight. Beauty is the confident jointing with and participation in the spirit.

Morality and goodness imply a radical contradiction between what is and what ought to be. This contradiction cannot be escaped, because in a universe of process, happening, event, and time, if what ought to be is what is, there would be no need for any new events, and the universe should instantly cease to exist (sound-waves and matter-waves would have to stop there, at their moment of perfection, for instance). If it did so, then "what ought to be" would no longer be "what is", because there would be no "what is". Contrariwise, if what ought to be is a process of improvement, how can one improve upon what ought to be? And again, if what ought to be is the existing state of process, but not of improvement (one version of the existentialist position), then when that aimless process brings about gas-chambers, for instance, that too is what ought to be.

This paradox is right at the level of complexity of the human world, and it is unsolved. It is isomorphic with the mutual dependence and mutual contradiction of justice and mercy, human death and human immortality. It is the equivalent for us of what the statement "this statement is unprovable" is for the logical system that contains it; it points to a further breakthrough, a further integration in the evolution of the universe (one which will bring about its own characteristic unsolvable paradoxes). The paradox is at the heart of tragedy, and is a restatement of the fundamental cause of shame. The only way we can apprehend it is as beauty. If we do not act upon the difference between what is and what ought to be, we neglect our moral duty; but if we so act without accepting the shame of the necessity of that difference, and without the sense of its beauty, we will become ideologues and moral monsters.

If the sense of beauty, then, is the gentle guide both to truth and to goodness, and if beauty itself, as defined here, is their inner principle, what are the implications for our present moment in history?

Evidently it is incumbent on us, it is our good duty, to nurture the

creative process of nature and to continue it in our own work. How?

Fundamentally, of course, we must listen for the voice of beauty. But the history of that creative process gives us some strong indications of where it would be best to listen — what policy will most immediately put us in the way of the muses.

First, we must educate ourselves and our children in the great neuro-charms, the biocultural artistic traditions; and that means that we must find out a great deal more about them, both by consulting the ancient mystical and craftsmanly techniques by which they were evoked, and by new scientific research. This combination of cultural rediscovery and neurobiological discovery will give the next century a special flavor and quality of its own. The new age that is coming will fall into that class of historical periods that we call renaissances — periods when past wisdom and beauty are recovered, inspiring radical innovations and changes. Modernism is an old idea now, in some senses over two hundred years old.

It is like the late middle ages in its repetitions in elaborated forms of older ideas, and in its rigid doctrinal orthodoxy. Postmodernism is at best a transitional period, at worst the last gasp of modernism. The research and education that will bring in the new era are going to happen anyway. For medical and business reasons we will be exploring more and more the art of the neural-cybernetic interface, taking up where military uses, we can dare to hope, will leave off. This exploration will lead to a recovery of part of the biocultural heritage that was denied to us by modernity.

If we are to do this, however — and this is the second “policy choice” by which we can improve our chances of encounter with the muses — we must make a great politico-cultural turn and abandon our attempts to deny the shame of our nature and history. We must accept our animal nature, the terrible sacrifices that we made to alter that nature, the validity of the higher moral and rational essences by which we judge and are judged, the shameful hierarchy of being that sets us in so special a place and makes such high demands on us, the very fact that we had our origins as suckling babies at our mothers’ breasts and as hairy beasts grooming each other for fleas, and the naked self consciousness in which we men and women see ourselves, as sexually-differentiated and sexually-reproducing beings destined for death. This set of acceptances involves a renunciation of that poisonous political drug, the ideology of right and left, the ide-

ology of the denial of shame. And it means a rejection of the explanatory convenience of, and desire for, coercive power.

The third "policy choice" is that we should study, and allow ourselves to be guided by, the trendline of nature as it evolved and articulated itself from its immaterial beginnings, through the realms of matter and of life, and into the yet swifter and more self-reflective world of culture and consciousness. Large parts of the universe have simply not had the chance to go through much of a development, and have become, as it were, stuck in a backwater or a dead end of unchangingness; free-flying photons and neutrinos on the subatomic level, cold gases in the interstellar medium on the molecular level, protozoa and anaerobic bacteria on the organic level, the ancient family of sharks on the vertebrate level. But whenever fruitful paradoxes, high energy gradients, and new ecological niches opened up, the evolutionary process tended to produce more complex, integrated, sensitive, self-reflective and actively transformative beings. And it has done so in an accelerating manner; and the furthest and swiftest achievement of the process, as far as we know and as far as we can responsibly act on, is ourselves. "By their fruits ye shall know them". If nature, given its head and allowed the richest field of choice and change, produces us, then we are the most natural of all entities, most characteristic of what nature is really like.

The process of accelerating evolution that the universe displays can also be described as a process of increasingly sophisticated natural technology. The bodies of even primitive living organism are fantastically complex pieces of electrical, mechanical, and chemical microtechnology, designed for movement, digestion, self-defense, and reproduction, with the function of preserving and promoting the genes. Human technology is a continuation and supplement to that natural technology, and the acceleration of the human technology is a continuation of the acceleration of the natural. Though the passions aroused by the issue denote our old friend the denial of shame and the mistaken nostalgia for purity, there is some justified alarm about the impact of human technology upon the natural technology that underlies it. But if we look at the trendline of natural technology, we can find a guide for human technology : human technology should become faster more inward, more economical, more spiritual, more self-aware and self-critical, more holistic, more hospitable to the growth of complex ecosystems and other species. As it does so it will change from being a net destroyer of biological information and

(larger) net creator of mental-cultural information, to being a net creator of both.

I have deliberately used rather ugly and abrasive terms in this discussion of technology, because we need to face the cognitive and moral unpleasantness, the shame, of this topic before we can go on from there to the beauty of which it is the portal. For the secret is that technology is art, as the renaissance knew well, and as we in our modernist metaphysical prudishness have forgotten. Indeed, there is much bad art. The answer is not to abolish art but to improve it, and to do this we must face all we have denied. The natural technology of the universe — the means that nature has found to preserve and enrich the existence of its inhabitants, living and non-living — is the exquisitely beautiful realm of hierarchical, dynamic, interdependent form that opens itself to our senses, and which our senses and brains are so marvellously designed to perceive. It is up to us to continue our art-technology in the same spirit, but into even richer domains of complexity, ecological influence, self-reflectiveness and fertile paradox.

And this leads us to a fourth policy-decision, which is theological. Voltaire said that if God did not exist, then it would be necessary to invent Him. Perhaps we could amend Voltaire's premise, and say that if God, or the gods, are beginning to come into existence, then it is necessary for us to help. The universe, as contemporary science paints it, resembles nothing so much as an embryonic God, or perhaps an embryonic community of gods. The embryo has already been fertilized and begun its explosive growth in the Big Bang. It has passed from a vegetative to an active and sensitive stage, with the emergence of life. It has already developed a notochord, that infolding and self-defining mass of tissue that will one day be a nervous system; that is the brains and communities of the higher animals. Our work is to become and create a brain or collection of brains worthy of a divine mind, and to innervate the relatively insensitive parts of the universe, allowing them to communicate with us and each other, as the fetal brain innervates the fetal body. I believe that the element of the ineffable, the mystical, the intangible, the terrifyingly beyond, in beauty is precisely the emergence of that divine mind. Beauty is like the pathfinder tracks, rich with pleasure-reward peptides, that are laid down first within the embryonic human brain, and that neural dendrites follow to link up with each other and wire the

neurons and the body together. But to wire up the divine mind ! — surely our shame is related to our known unworthiness for such a task. But it is *our* task; that is what our neurocharms were designed for.

I have suggested elsewhere what directions offer themselves for the artistic technology or technological art of the future. Our first tentative steps in the preservation of endangered species and ecologies, and the restoration of damaged environments, is one kind of beginning. Another is the research in genetic engineering, which may one day offer the possibility of restoring extinct species by selective activation of the genes of living species that are not presently expressed, and even the creation of new species and new ecologies. Another is the seeding of dead planets in this solar system and other solar systems with genetically modified, and later, wild forms of earthly life. Another is the creation of artificial intelligence. The traditional arts can be accurately described as artificial intelligence programs designed to run on organic computers (human brains); and the use of silicon hardware, and then perhaps artificial circuitry, may add a startling new feedback loop to this ancient magic. Yet another direction we may take is the creation of virtual realities, cyberspaces linked up to the human nervous system.

These possibilities are really no more bizarre than the new technical resources of the renaissance would have appeared to a person of the middle ages. What might truly astonish the medieval person transplanted in time into the renaissance would have been the apparent resurrection, with a strange new flavor, of a world that he or she would have considered not only pagan, disquieting, and outdated, but extinct : the world of the ancient Greek and Romans. If we were to be similarly transplanted into the mid-twenty-first century we would, I believe, be most surprised not by the expected innovations, but by the way that all of human cultural and biological history will have become part of the landscape; by how magically corny, how shamefully old-fashioned, how primate-like and tribal we will be among the almost invisible and intangible miracles of our technology; by how slow and quiet everything will be, how improvised, how richly ornamented; how closely we will live with the animals and plants, how much in the open air; how gorgeously and formally and anachronistically clothed we will be, how morally earnest and at the same time how lighthearted, how accepting of shame and tragedy; how much also as we lived in the great pedestrian cities of the civilized past. And most of all we would be surprised by the strange, familiar, epiphanic

beauty we would find there, a beauty like that of a girl going to a party in her mother's dress.

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