



SELF-ORGANIZATION, EVOLUTION, AND THE CADUCEUS

by

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The serpent or dragon has a fair claim to be a universal human symbol. We can find it, for instance, in the form of the winged serpent Quetzal of the Aztecs or Kukulcan of the Maya; as the dragon of Welsh mythology and Celtic myth in general; as the wise snake of the Bible, and Gilgamesh, the serpent of the *Enuma Elish*, the "Rainbow Snake" of the Australian Aborigines, the dragons and serpents of Chinese, Anglo-Saxon, Hindu, Buddhist, Nazca and African iconology. Knight and Power, in their interesting collaboration--their full-moon festival, as one might put it--have given us a wealth of examples from the world's stores of myth and ritual.

This paper will focus upon a particular version of the serpent symbol within a connected group of Mediterranean and Near Eastern cultures: the snake-staff of Hermes, Mercury, Moses, and Aesculapius. The symbol was already ancient when it appears in the mythology of the Hebrews, Greeks, and Romans. Snakes twine about the terracotta arms of tiny Minoan goddesses. The Sumerian court physicians of circa 2,000 B.C.E. carried a staff entwined with two serpents as a sign of their office. The mediator-god Ningizzida, whose symbol is the snake-entwined staff, is depicted in bas-reliefs from the Mesopotamian city of Lagash conducting the king, Gudea, into the presence of the supreme god Enki. (John Armstrong: *The Paradise Myth*, Oxford University Press, 1969--a most useful book for this study.) The iconography of the Edenic serpent, coiled around the Tree of Knowledge, may be older still, and the story of the serpent in *Gilgamesh*, which, clearly in the same tradition, steals the herb of immortality that the hero has obtained, may be as much as 6,000 years old. The twined-snakes visual motif can also be found in ancient Hindu diagrams of the *chakras*, or energy centers, in the human body. Where the snakes intersect--at the caste point between the eyes, the heart, the navel, the genitals, and so on--the chakras are found. It

may even be implied by the yin-yang symbol of East Asia. In Norse mythology, the roots of the world-tree Yggdrasil are gnawed by the world-serpent Nidhoggr.

The snaky rod is called the Karykeion, or messenger's staff, by the Greeks, and the Caduceus by the Romans. In its earliest Greek form it appears as a forked stick, the branches knotted to form a loop, but later the staff is twined about by two serpents in a helical embrace, the heads facing each other. This is the form it takes in Roman iconography. The visual motif of the snake-encircled tree is a pervasive motif in Roman funerary statuary, where a hero, almost always accompanied by a horse and a dog, pours a libation with his consort to the psychopomp, Mercury. It is also familiar in the story of Hercules, who must contend with a serpent coiled around the tree when he goes to fetch the golden apples of the Hesperides. The myth scholar Jane Harrison believes that the combination represents Life, and she is clearly right as far as she goes. But the equally strong death associations--the snake/tree seems to grow at hellmouths, between life and death--should make us question further.

There are various Greco-Roman myths of the origin of the caduceus. One is that Hermes came across two snakes fighting each other, and found a way to turn their war into love. He took a staff, given him by Aesculapius, and threw it between the snakes, whereupon they twined around it in the familiar double helix. At once they ceased their conflict; war turned to love, hostility to copulation.

It will be immediately evident that this myth is closely related to the story of Teiresias, who, seeing two snakes mating, killed the female, whereupon he turned into a woman. Seven years later he again saw two copulating snakes, and this time killed the male, upon which he reverted to being a man. Zeus and Hera, who had been arguing about whether men or women derived more pleasure from sex--Zeus maintaining that women did, Hera that men did--took the opportunity to ask

Teiresias , who had experienced sex as both a man and a woman. He replied that women derived ten times more pleasure from sex than men. Hera, angered by this response, blinded Teiresias. A different version of the tale of Teiresias' blinding also casts light on its meaning--that Teiresias was punished by Athena, the goddess of wisdom, as Actaeon was by Artemis/Diana, for watching her bathe naked. In any case, as compensation for Teiresias' blindness, Zeus conferred on him the gifts of prophecy and longevity.

What are we to make of this rich mess of tales? The copulating snakes stories clearly establish the meaning of the caduceus as, generally, life itself; more specifically, life as reproduction, and more specifically still, life as sexual reproduction. By an amazing coincidence, the fundamental life-symbol of the ancient world happens to be a pretty exact diagram of the DNA molecule, in which two strands of bases or nucleotides, strung along a chain of phosphate groups, coil in a double helix around a central sequence of weak hydrogen bonds. I will argue later that this correspondence is more than a coincidence.

Some versions of the copulating snakes myth seem to indicate that the sexual harmony of opposites is achieved against a background of sexual strife--a strife which is itself acknowledged in myth terms to be necessary and beneficial. There is an echo in the story of Teiresias' punishment of the more dreadful fate--foretold by Teiresias in Euripides' play--of King Pentheus, who likewise gazed upon forbidden female sexual mysteries. The "moral" of that tale, as of the related story of the dismemberment of Orpheus by the Bacchantes, is that there must be a complementary balance between the warring powers of Apollo and Dionysus. Teiresias' attempts, before he has acquired this wisdom, to restore peace by removing one side or the other in the battle results in a compensatory and catastrophic metamorphosis of his own sexuality; and the strife of Zeus and Hera is the cause of Teiresias' distinguishing gifts of prophecy and long life. In some sense, then, the gift of knowledge is related to the tension between sexual hostility and sexual amity, and to the

sense of shame experienced by all three characters (and by Athena in the observed bathing myth). The parallel with the Biblical story of Eden is obvious.

The central element of the myth is a snake wrapped around a tree--the supreme symbol of the disruption of order and protean transformation, embracing the supreme symbol of stability, order, and continuity. The snake, whose venom can both poison and, in the hands of a physician, heal--which dies but is reborn when it sheds its skin--is linguistic slippage personified. But it is reconciled symbolically in the caduceus with the staff or tree, whose ancient significance is suggested by the fact that the word "tree" itself is derived from the Indo-European root *deru-*, which also gave us the words true, trust, and troth--the keeping of promises and the continuity of meaning.

The speculations of contemporary evolutionary biology on the origins of sexual reproduction show interesting resemblances to the meditations of these ancient mediterranean mythmakers. Geneticists suggest that sex arose out of conflicts on the micromolecular level between viral invaders and the host DNA, and between the need for genetic stability and the need for genetic variation. Ethologists and sociobiologists attribute the elaborate ritual behaviors and ardent pair-bonding of sexually-reproducing species to conflicts between territorial/aggressive drives and simple copulatory drives, some--for instance, Konrad Lorenz--even suggesting that the pressure-cooker of sociosexual selection and competition drove the emergence of higher cognitive faculties and self-awareness, and the concomitant extension of lifespan required by species that must learn the complexities of social sexuality. Teiresias the shaman, the ritual adept, acquires his expertise in the future and his longevity, just as the human species apparently did, through an elaboration of a sexual dialectic; a dialectic found, in an even more economical form, in the Hebrew identification of sexual with mental "knowing".

The other major branch of Greek and Roman myths that deal with the caduceus involves its exchange for the lyre, the contract between Apollo and Hermes. What does the trade mean? To answer this question we must come to a deep understanding of the meaning of the lyre and the meaning of the god Apollo. In yet another story, the caduceus came into the possession of Hermes/Mercury by means of an exchange. Mercury had already invented the lyre, using forked sticks and the shell of a turtle. He traded the lyre to Apollo, who gave him in exchange the caduceus, which was originally in his possession. Apollo then gave the lyre to his son Orpheus, who later used it as the essential talisman to pass as a living man through the gates of the underworld in his quest for Eurydice, and return unharmed. The lyre was, of course, the instrument by which Greek poets marked the metrical divisions of their oral poetry--the ancestor of the instrument by which modern Serbian and Bosnian *guslers*, or oral poets, punctuate their epic verses on the battle of Kosovo. In myths and folktales trading usually indicates symbolic equivalence, or at least a further, leaked-over, meaning for each of the objects traded.

The tradition in which Apollo, not Hermes, was the original possessor of the caduceus, is also supported by the fact that Aesculapius, the god of medicine, is another possessor of the caduceus (now the symbol of the *pharmakon*) having got it, presumably, from his father Apollo. Apollo was originally not a very "Apolline" god at all, being associated with plagues and arrow-wounds, and nicknamed "Smintheus," the mouse-god. In ceding the caduceus to Hermes and taking on the lyre instead, he is being cleansed of his more earthy and organic Dionysian connections, and prepared for his role as the sun-god of reason and order. Likewise, he slays the serpent Python and takes over the Delphic cult from the old chthonian goddesses who governed it before; but the ancient associations cannot be dispelled. The oracle is a woman, not a man, and she uses the laurel leaf, from the tree of the nymph Daphne who rejected Apollo's advances, as her psychotropic agent to achieve the oracular trance.

The best and most succinct gloss I know on the subject of Apollo's lyre is Rilke's third sonnet to Orpheus (first series), which I quote in A.J. Poulin's translation:

A god can do it. But tell me, will you, how
a man can trail him through the narrow lyre?
His mind is forked. Where two heart's arteries
intersect, there stands no temple for Apollo.

Singing, as you teach us, isn't desiring,
nor luring something conquered in the end.
Singing is Being. For a god, it's almost nothing.
But when do we exist? And when does he spend

the earth and stars on our being? Young man,
your loving isn't it, even if your mouth
is pried open by your voice--learn

to forget your impulsive song. Soon it will end.
True singing is a different kind of breath.
A breath about nothing. A gust in the god. A wind.

Rilke remembers that the lyre, like the caduceus, began as a branched stick. The journey of the poet is the shamanic one: to pass down the branches of the mind's--not the body's--arterial tree into the underworld. Shamans need certain specific skills, that are symbolized in the old underworld stories by the golden bough, the lyre, the clue, the magic flute, the shamanic drum or bagpipe, the spirit-doctor's rattle, or the mask of the angakoq. These talismans refer to the ancient

techniques of the arts--melodic structure, poetic meter, dramatic mimesis, the picturing power and pattern design of the visual artist, storytelling, and so on. New research is showing that these artistic forms have a double nature, a twofold loop structure like the figure eight or the infinity sign, with one feedback loop inside, within the neuroanatomy of the human brain, and one feedback loop outside in the cultural tradition.

Poetic meter, for instance, is culturally universal on all continents and in all societies from the most technologically simple and isolated to the most advanced and cosmopolitan, with one interesting exception--the Western free verse of the last eighty years. The human poetic line, with this one exception, is always about three seconds long, rhythmically shaped by regular patterns of long and short, heavy and light, or tone-changing and tone-unchanging syllables, and by such devices as rhyme and alliteration. The three second line is tuned to the three second information processing cycle in the brain, which preserves three seconds of short-term memory before storing its essentials as long-term memory and forgetting the rest. If this internal cycle is driven by the external rhythmic stimulus of poetic meter, significant changes in brain activity and brain chemistry occur, as studies of the effects of ritual chanting have shown. The right brain becomes just as active as the left, the limbic system is awoken, and a cocktail of neurotransmitters is released, whose known properties combine alertness, relaxation, pleasure, and challenge. Listening to poetry literally makes us smarter--just as listening to Mozart has been shown to do by recent research.

The Orphic poet uses his lyre as Theseus used his ball of twine, to enter the labyrinth of the human racial past and to return. As Rilke says in sonnet 17:

Deep down, the oldest
tangled root of all that's grown,

the secret source
they've never seen.

Helmet and horn of hunters,
old men's truths,
wrath of brothers,
women like lutes . . .

Branch pushing branch,
not one of them free . . .
One! oh, climb higher . . . higher . . .

Yet they still break.
But this one finally
bends into a lyre.

In a few brief lines Rilke here recapitulates the entire Darwinian evolutionary tree of humankind, with glimpses of the growth of primitive hunting technology, the rituals and social structures of kinship, the Venus of Willendorf, the first arts. Through tragic waste and amputated branches the process refines itself into freedom and spirit. The lyre actually grows out of Darwin's tree of evolutionary descent, as its flower (and perhaps as the seed of a future tree).

Thus the lyre itself, in the sense of poetic meter and the other traditional artistic techniques, was both a product of the evolutionary process and, as it articulated itself, the guide of evolution. The human species is, technically, a domesticated species: the domesticators being ourselves and the method being artistic ritual leading to differential reproductive success. Like the human race itself,

which eventually renounced its ancient eugenics and called upon its ritual adepts and priests to be celibate, Rilke too rejects the merely sexual compulsions that were human evolution's first fuel--"learn to forget your impulsive song". No temple to Apollo stands at the blood's meetings of three ways; the temple is raised at another crossroads, where the mind's Oedipal questionings lead us to forbidden knowledge of our own origins. But the mental branching grows out of the biological; the tree of knowledge is a branch of the tree of life.

Thus one meaning of the trade of caduceus for lyre is that the caduceus, the mechanism of life, can develop into the lyre, the art of poetry, or that poetry is at bottom the further workings of the mysterious language of living organism. The myth is thus a myth of the origin of language. In modern terms we might say that the trade recognizes the deep parallelism between the discrete combinatorial generative system of DNA and those of human grammar and human poetic meter, and celebrates the latter as an outgrowth of the former. Poetry is fast evolution. Biological evolution is slow poetry.

Another meaning implicit in the trade is the idea of trade itself. The very transaction by which the meanings of the caduceus and the lyre are brought into relationship with each other is itself part of their significance. Mercury was among other things the god of commerce. The Latin *merx* meant merchandise, in the sense that merchandise was something under the purview of the god. His name is cognate with mercenary, merchant, mercantile, commerce, and market itself. It is also the root of mercy; but how can the market be merciful? Isn't it counter-intuitive that mercy--and *merci*, the French word for thanks--should come from the same linguistic root as mercenary? What does the legendary ruthlessness of the marketplace have to do with the free gifts of compassion? If, using the excellent American Heritage Dictionary, we follow the etymology of this root back to its Etruscan origins, we find the same ambiguity all the way down. The Old French *merci* meant forbearance to someone in one's power; the Late Latin *merces* meant reward, but also God's

gratuitous compassion.

Those who in the Marxist tradition persist in seeing the market as impersonal and merciless, are comparing it by implication with the intimate world of uncounted cost and unquestioned trust that they believe exists in the family, in a friendship, in a traditional tribal village or in a non-profit organization dedicated to some higher voluntary purpose or liberal art. Perhaps the market is less forgiving than such communities, though anthropologists, sociologists, and novelists have charted the often ruthless politics and unyielding cruelty of families, villages, and universities. But communities of this kind are not the alternative to the market, nor has the market shown any sign of putting an end to them--they flourish still as they always did, and their sphere in society is proportionately no smaller in relation to the market than it ever was. There are two real alternatives to the market. One is the way that communities actually treat strangers and outsiders, and the way communities traditionally treat each other, when they are not trading with each other or governed by a higher authority: that is, by enslavement, murder, and war. The other is the utopian rule of an abstract justice in which there could be no room for mercy, since any communication or gift or exchange other than the application of the law would amount to corruption and favoritism. The market is the place where one can begin to communicate with strangers, where one can negotiate, where there is time to haggle and latitude for error, where a loan can be prolonged (with a "grace" period) because the lender wants his money back, where defeat does not mean extinction but the opportunity to pull off a better deal another day. It encourages a basic level of civility, and requires of those who would profit by it a preparedness to take risks in trusting others, even if the risktaking is the margin for error in the quantification of risk when one is estimating the interest one should charge on a loan.

Mercury is an extremely interesting god in this context: as well as being associated with markets, he was the divine messenger, the god of travel and of thieves, and the psychopomp, that is, the

god who conducted the souls of the dead to their final destination, whether Hades or the Elysian Fields. Perhaps we can make sense of him thus: being the spirit of communication and exchange, he is that which allows whole systems of connected feedback to come into being. He is thus the patron of change, since systems can change only to the extent to which they can communicate within themselves and with other systems. Merchants, the "middlemen" of human exchange and often the carriers of news, information, new science, and socially disruptive ideas and diseases, take Mercury to be their leader. The marketplace is the place where both goods and ideas are exchanged, and thus it bears the god's name. Naturally all the illegitimate and cheating forms of communication and exchange--lying and stealing--are also under his aegis. Mercy is kin to thievery; both are unjust. Naturally, too, Mercury conducts human consciousness--itself the product of the internal communication of self-awareness and the external communication of exchange with other human beings in the marketplace of life--across the greatest threshold of change, from life to death.

When we look at some of Mercury's other attributes and associations, he becomes more interesting still. He gives his name to the metal that is liquid, quicksilver, that cannot be held in one place but runs away. Mercy--the things of Mercury--is essentially liquid. It "droppeth," as Portia says in *The Merchant of Venice*, "as the gentle rain from heaven," and is not "strained," however fine the mesh by which we try to strain it out. In alchemy, mercury was one of the two primary opposites, sulphur--a solid--being the other, whose true union through the evolutionary process of alchemical metamorphosis produced perfect gold. Mercury's planet was the harbinger of the two great diurnal changes, day into night and night into day, and thus the link between the day world and the night world: again, Mercury is the reconciler of opposites.

One final detail of the visual iconography of the Greco-Roman caduceus now comes into focus. The two snakes are usually shown facing each other. Thus the image is one of self-reference, of

feedback, like the familiar "hall of mirrors" effect created when two reflecting surfaces face each other. Sometimes the two snakes are bearded, denoting wisdom, maturity, and the self-knowledge expressed in the phrase "nosce teipsum." Thus the caduceus contains within itself an intriguing suite of significances, from the purely biological, through the economic and the artistic, to the realms of self-consciousness and the soul.

The significances I have adduced here for the caduceus might arguably seem tenuous or at least idiosyncratic to the Greco-Roman tradition. But a similar constellation of meanings emerges when we turn our attention to the mythology and commentary of the Jewish tradition. Here my scholarship is even more incomplete, but the material is so rich that even a superficial treatment reveals highly suggestive parallels.

The Hebrews' version of the caduceus is a staff--Moses' rod--which can metamorphose by magic into a snake, and can by the power of Jahweh turn back into a staff. The distinction between the two transformations is emphasized by the story of Moses' contest with the Egyptian magicians in *Exodus*, in which the Egyptians, like Moses, are able to turn their staffs into snakes and bring plagues upon the lands, but Moses' staff-snake eats up the snakes of the magicians. The *Zohar*, a remarkable Kabbalistic work from mediaeval Spain, expatiates: the Egyptians cannot turn their snakes back into staffs or dispel the plagues, whereas Moses can reverse the process. The Egyptians are good deconstructionists, but only Moses can manage the necessary reconstruction.

I believe the *Zohar* is right in discerning a symbolic correspondence among the many rods, wands, or staffs by which the power of Jahweh is exercised in the Hebrew Bible. Moses' rod is usually associated with the mediator-angel Metatron in Jewish folktale and mysticism; the legend is that the rod or staff was originally a branch of the Edenic Tree of Life, and was plucked from the tree by the angel. (Angelo S. Rappoport's *Ancient Israel: Myths and Legends*, Bonanza Books, New

York 1987, is a useful source.) Metatron is evidently related to the Mesopotamian god Ningizzida, who is like Metatron a messenger, a mediator between the divine and the human, and a psychopomp. Ningizzida is sometimes depicted with the two snakes emerging from his shoulders.

Moses first obtains the rod during his exile in Midian, when he is commissioned by the Lord of the Burning Bush to lead the chosen people into freedom, and his lips are circumcised by the fiery coal of Jahweh. When Moses raises the rod, the Israelites are victorious in battle. He uses it to part the waters of the Red Sea, and to strike the rock and create a spring of life-giving water during the sojourn in the desert of Sinai. More mysterious still is the role played by the staff when the chosen people begin to doubt the promises of God, and they are bitten by snakes and fall sick. Moses, taking the role of Aesculapius, then constructs a caduceus--a bronze snake upon a staff--and raises it up before the people. Whoever merely looks upon the serpent is cured. Recalling this ancient episode near the beginning of the Gospel of John, Jesus likens himself, as healer, to this serpent fastened to the tree; and thus we may see the icon of the crucifix as itself a version of the caduceus, with the cross as staff and the savior as snake.

In much Western iconography, the snake is symbolically equivalent to the newborn child, especially the foundling child or the child born outside the normal limits of society. Moses' name is the Egyptian term for "son of", a constant reminder of his strange foundling status, his origin among the bullrushes of the great snake of the Nile, and his adoption by the Uraeus-wearing daughter of the Pharaoh. Milton, in the Nativity Ode, likens Christ to the infant Hercules, who strangled snakes in his cradle. I have seen Celtic crosses in Galicia, the Celtic region of Spain, which on one side carry the crucified Christ, but which on the other carry, also crucified as it were, the Virgin mother, in exile, with her baby child.

In the Jewish Bible the rod reappears again and again. Of particular interest is its role in the story

of Jacob and Laban. In the story Jacob serves as the ranch manager for his uncle and father-in-law Laban, who is a hard man who reaps where he does not sow. Jacob is so expert and creative in his work that he makes Laban rich, and despite the fact that Laban keeps changing the rules of his employment, Jacob ends up with both of Laban's daughters and huge flocks and herds of his own. He serves seven years for Laban's elder daughter Leah, seven years for the younger daughter Rachel, and six years for his share of Laban's flocks and herds. Jacob's peculiar expertise seems to be in animal breeding: he mates the most vigorous stock in his uncle's herds and improves the breeds. His knowledge of stockbreeding is symbolized by the rather mysterious procedure of setting up a peeled branch before the herds when they come to drink; this peeled branch is interpreted in the Kabbala as being related to the Metatron-rod of Moses. Like Moses' healing bronze snake/staff, the the peeled branch is efficacious simply by virtue of being held up and seen. As we have already noted, the caduceus is an exact diagram of the double-helix DNA molecule. Jacob is evidently a ancient expert in recombinant DNA. Simply to know how snake and staff can be reconciled is sufficient to produce healing and fertility. Jacob's genetic expertise, the story insists, is taught to him by God, who also promises to bless Jacob himself with a multitude of descendants.

The rod of Jacob and Moses is also connected in the *Zohar* with the institution of circumcision, the process by which a Hebrew male was enabled to give birth to himself a second time and be reborn in the spirit. In the *Zohar*, as the anthropologist Harriet Lyons interprets it in a brilliant unpublished Oxford B.Litt thesis, the peeled branch of Jacob is a willow-sapling whose bark has been removed to reveal a part white and part red inner body. This wand, which combines the red of transgression with the white of purity, is associated with various mediating figures: Metatron, the mediating angel; Jacob himself, who mediates between the gentleness of Abraham and the severity of Isaac; the Sabbath, the time that mediates between ordinary human time and the time of God; the Shekinah, the mystical female spirit of the chosen people, who as the bride of Jahweh

mediates between individual Jews and God; and the male and female principles in general. Circumcision in this view symbolically provides a man with an orifice like a woman's through which he can give birth to himself a second time--in nice accord, one might note, with the theories of genital mutilation provided by Knight and Power. Moses, significantly enough, as a foster-Egyptian, was not circumcised. During his return from the land of Midian to Egypt the angel of God, angry at his impurity, takes the form of a great serpent one night and swallows him down to his feet--almost returning him to the animal womb. Moses' wife Zipporah rescues him by circumcising their baby son and smearing the blood upon Moses' feet. In so doing she transgressively takes the role of the male Briss. Furthermore, this is a symbolic circumcision of Moses himself, as she explains when she says to him: "truly now thou art a bridegroom of blood unto me." Jacob's rod, then, is part of a symbol-complex which includes both biological life and the cultural or spiritual transcendence of life.

Thus among other things the Jacob story is about what one might call traditional evolutionary theory. Success is defined as reproductive success; Jacob is the fittest in these terms. He himself sires twelve sons by various women. He prospers by acting as a selective force on his herds, accelerating their evolution by what in modern terms we would call genetic engineering. What the story says about God is that God is the spirit of evolution and the true guide for what will survive into the future. But God, like Laban, reaps where He does not sow: a rentier, so to speak, an owner of the means of production who gives employment to his workers. God, like Laban, is a kind of friendly adversary whose demands for repayment create the economic discipline and stimulate the technical ingenuity that ensure prosperity, and whose arbitrary tests warrant the survivor as the rightful heir to the future. The Bible story hammers this point home by having Jacob wrestle all night with a man (usually interpreted as an angel) who actually turns out to have been God Himself. Jacob suffers a torn sinew in his thigh from this battle, but gets in recompense a divine blessing, and a new name: Israel, that is, the position of ancestor to the whole nation.

Jacob, the great saver, is saved.

Jesus' parable of the talents is clearly a gloss upon this story. The kingdom of Heaven, he says, is like a wealthy man who goes travelling, and lends his three servants money (reckoned in weights of specie called talents) until his return. The servant that gets five talents uses the money to trade, and doubles the money to ten, which he gives to his master on his return. The servant that gets two talents also doubles the money, to four, and renders it to his master. The wealthy man praises these two servants and promotes them, effectively making them partners in his firm. The third servant buries his talent in the ground and repays it unriskened and unenhanced, explaining that he was afraid that the master, who has a hard reputation of reaping where he has not sown, would blame him if he lost the money in a risky venture. The master condemns him, and orders the one talent to be taken away and given to the servant with ten talents, explaining angrily that the one-talent servant should at least have "put the money to the exchangers"--played the financial market--so that he could have given it back with usury (interest). "For unto every one that hath shall be given," Jesus concludes, ". . . but from him that hath not shall be taken away even that which he hath."

In the parable the Master expects a return on his money equivalent to what a competent money manager could get by playing the financial markets over the period of time the Master is away. The interest rate represents the cost of time. In present-day scientific terms the cost of time is the increase of entropy, or thermodynamic disorder. In human life the increase of entropy shows up in the process of aging--including the onset of menopause, which is a key element in the Jacob and Laban story and in the whole related cycle of stories in *Genesis*. We, and the physical world around us, wear out over time. The order that we inherit is a loan, which not only must be repaid, but also carries with it a finance charge; the repayment is death, and the finance charge is aging. But two of the servants in the story manage to beat the entropic market rate. Jesus says that they

do it through trade, which means that if he has the Jacob and Laban story in mind, which he surely must, Jesus equates trade with the process of evolutionary husbandry practiced by Jacob. In other parables of production, such as that of the sower, Jesus explicitly outlines the process of natural selection that enables one seed to bring forth a hundredfold while another brings forth only fortyfold and another none at all. Thus trade, or productive business, is the continuation of the natural process of creative evolution, and it is one way in which we can use the investment loan of our lives and the available resources of nature to beat the interest rate of entropy.

These economics coincide closely with certain leading ideas in contemporary cosmological physics. The universe is subject to the increase of thermodynamic disorder over time; the demands of Laban and of the Master in the parable cannot be denied. But other processes are at work. The enormous pressure within the dense primal fireball causes it to expand. As the universe expands, it cools. The cooling process itself triggers spontaneous symmetry-breaking, as when crystals suddenly form in a supersaturated cooling solution, or frost-flowers blossom on a winter windowpane. Crystals and frost may seem very symmetrical, but they are much less so, forming along specific planes and axes as they do, than the omnidirectional symmetry of the liquid or vapor that gave them birth. That symmetry-breaking can give rise to higher levels of order, embodied in more and more complex molecular forms whose asymmetries paradoxically provide a whole new field of opportunities for new kinds of symmetry to emerge. These forms must in turn compete with one another for survival, and thus further elaborate themselves, until in at least one place in the universe they generated the amazing variety of living organisms, including Jacob's rams and ewes, and Jacob himself. Thus the evolutionary view of the universe corresponds nicely with the Biblical conception that life is a debt to be repaid with interest, but also an investment, which if properly used can yield a return superior to the interest rate.

What is it, in the Hebrew tradition, that the "caduceizing" of a human being by circumcision

enables him to do? It is not only to have the wit for selective breeding and breeding money by trade; nor is it only to be certified as cultural, as "cooked," so to speak, and thus separated off from raw nature. It is, paramountly, to be qualified for Yeshiva and the interpretation of the Talmud. As with the ritual of married sexual congress, the right time for that gentle disputation over the Law is at midnight on the Sabbath. It is the place where Jahweh celebrates his nuptials with the Shekinah. The interpretation of the Book is the Hebrew equivalent of the Greek ritual of poetry and drama; the peeled rod is ritually exchangeable for the celebration of the meaning of the word, the singing of the divine verses, just as the caduceus is exchangeable for the lyre.

We can, therefore, summarize the meaning of this ancient symbol in terms of a cascade of transcendences. The snake-encircled tree is certainly a symbol of life; but it is also a symbol of the transcendence of mere life by means of a dialectic which includes death itself. The snake venom can kill or cure. The tree merely grows--though it branches, and thus opens up a future richer than the past. But the snake renews itself, changing its skin in a symbolic death and rebirth, unpeeling itself from itself. The snake breaks the rules. In biological terms we see imaged here the moment of evolutionary transition from asexual reproduction to sexual reproduction--an innovation which, in evolutionary history, carried with it a complementary invention, genetically programmed death by aging. Sex and death are one process; programmed death clears out each older generation to make room for the next generation, created as true unique individuals by the genetic reshuffling of sex. After billions of years of glacially slow asexual evolution by mutation and selection unassisted by sexual recombination, sex made possible the acceleration of evolutionary change in the last few hundred million years that came with sexual selection and social behavior. Success in territorial and mating ritual, a criterion meaningful only at the level of social interaction, could begin to act as a powerful selective pressure of its own on the genome of the species, reversing the traditional causal flow from genotype to phenotype. Species could domesticate themselves to their own social requirements. In one case at least, the human, the sociocultural tail came to wag the

genetic dog; the innovation represented by the snake became coupled to the biological conservatism of the tree of descent. Thus in a further sense the caduceus symbolizes also the coevolution of biology and culture.

The next step in the cascade of transcendences is the emergence of market exchange as a pseudosexual system of ideational recombination. The market is in the realm of mind the equivalent of the interbreeding gene pool in the realm of biology. Like the tree, it branches out into new products, technology, bioengineering, systems of bondmaking, marketing and exchange; and like the snake, it renews itself reflexively and transgressively, engendering its own critique at crucial points of class or ethnic or gender struggle. Indeed, this step in the cascade of significances is the hardest for the academic humanities to accept, since the humanities themselves were created by the market partly as an institution to critique the market.

The final step in this cascade of meanings is suggested on the Greek side of the Mediterranean by the morphing of tree into lyre, the exchange of caduceus for lyre. On the Hebrew side it is symbolized by the rite of circumcision--the caduceizing of the male Jew that qualifies him for the poetic hermeneutics of Torah study. The pun on hermeneutics is intentional; Moses has long been associated with Hermes Trismegistus, the mythical Egyptian sage from whom we derive the term "hermetic." The creation and interpretation of poetry is the final significance of the caduceus. Genetic evolution is slow poetry; poetry is fast genetics.

Two objections might be raised to this set of interpretations. One is that by multiplying meanings I have deprived the symbol of any particular significance--what is in common among all these different referents? The other, more common-sense still, is how on earth people living millennia before even the invention of the microscope and the Darwinian discovery of evolution--let alone the identification by Watson and Crick of the double-helix structure of deoxyribonucleic acid--could

have made the biological connections I have suggested.

The answer to both objections is the same. The double helix is one of the best natural symbols--perhaps *the* best--of the processes of creative replication and feedback that underlie organic life, the evolution of sex, the coevolution of genes and culture, the workings of the market and the self-reflection of poetry and hermeneutics. Those processes are in their broad macroscopic outlines obvious to any thinking observer. But the caduceus is more than a symbol, it is an explicit diagram. A circle is clearly the simplest picture of a negative feedback loop, which cycles back to its beginning state and then repeats the procedure. If we add to the circular motion a linear movement--the simplest possible diagram of an irreversible change--we get a helix, which is the natural symbol of positive feedback, where repetition makes a difference and thus iteration can transform as well as reestablish. If the helix in turn generates its dialectical antithesis, we get a double helix and at the same time a more stable form, since each snake plays the role of figure to the other's ground. We also get a sort of printing system, whereby one snake serves as the "symbolon" of the other, the incomplete half of the coin or *bulla* from which the other half can be reconstructed or identified. The staff or tree between the two snakes is now the natural symbol of dialectical synthesis--and the loose ends, the heads and tails of the snakes, are the natural diagram of the partial open-endedness of the system.

Nature, then, could scarcely help "choosing" the double helix as the shape of its life-molecule; it is the geometrical essence of feedback, self-reference, and replication with cumulative and adaptive variation. And the sages of our human past were compelled both by their own evolutionary heritage and the economy of the diagram's descriptive power to choose the same form.

The tree--in particular, its branchings--is in turn the natural symbol of any process of differentiative growth, of hierarchical function, of the reconciliation of the many with the one, of ordered

relationship between local and global, and of family descent. Its three-way joint is a diagram of father, mother, child; of major premise, minor premise, and conclusion; of any logic gate such as a transistor or a grammatical copulative, with input, output, and control; of the branch point of the human body, where legs and torso meet at the organs of generation; of a decision on a decision-tree or a deadline on a schedule-tree; of free choice itself in irreversible time; of biological speciation; of the crystallization process by which the early cosmos of supergravity collapsed out into the four forces of physics and the complexities of the periodic table as the universe expanded and cooled. Hesiod's account of the birth of the gods, the Genesis story of creation, and all other creation accounts I know of, contain this implication of a branching out from the one into the many. Sophocles' *Oedipus Rex*, with its elegant pattern of three-way joints, contains most of my list, especially in the form of distortions or mutilations of the productive three-way junction: the baby Oedipus' stapled feet; the meeting of the three roads from Corinth, Thebes, and Delphi where Oedipus encounters and kills his father; the place to which Oedipus returns when he consummates his marriage; the catastrophic feedback loop in his family tree; the four, two, and three feet of the Sibyl's riddle, whose answer is its answerer and thus whose input gate is its output gate; the collapse of the syllogistic method Oedipus uses for his detective work when the conclusion turns out to be the major premise, the detective the criminal; and the terrible stapling together of one branch of the future with the past that is created by an infallible oracle of what is to come.

Recent developments in the study of the fractal geometry of nature, initiated by the French mathematician Benoit Mandelbrot, lend confirmation to the intuitive connection of tree and snake. What Mandelbrot showed was that nonlinear equations--equations in which the answer on one side of the equation was fed back as one of the terms on the other--tended to generate shapes when plotted in space that were utterly unlike the closed and continuous finite forms of classical geometry. They were, in essence, branchy--they developed themselves on an infinite cascade of scales into finer and finer articulations. Thus tree-shapes are the sign that a snakelike feedback

process has produced them, and the "dragons" of fractal geometry (as Mandelbrot christened them) are what are painted when any self-referential branching process is given its head and allowed to play itself out.

Indeed, when we examine the sheer geometry of the caduceus, the combination of snake and tree seems almost overdetermined, and its cascade of significances inevitable. We thus have a symbol with wide cultural distribution, one which may even be culturally universal in Eibesfeldt's sense of the term. I suspect that Kukulcan/Quetzal and the other coiled serpents of Mesoamerica, and the dragons of Knight and Power, may have the same basic iconography, and that study will reveal equivalents throughout the world. One of the interesting aspects of this particular human symbol is that in certain ways it overwhelms the comfortable distance we like to keep between the investigator or scholar and the material that is studied. Our own hermeneutics, our own investigation of the ideational womb from which we came, is predicted by the symbol itself.