likes, our dislikes, our hopes, and our fears. As any sense of self is dependent upon the detail and subtlety of recall, the better memory we have, the more self-conscious we will be. Animals, for all their variegated plumage and behavior, are remarkably similar to each other. All higher mammals exhibit personalities and levels of intelligence, but if dogs had character traits as complex as those of humans, they wouldn't be using their noses to greet each other. Reptiles are so lacking in observable personality that their manner is truly reptilian.

And yet basic communications are possible, emotions are communicated and understood, and one can actually embarrass gorillas and the other great apes, although it is unadvisable. Bigger brains do more than swell heads; they enable the development of complex personal and social structures. In comparison, an insect has no hopes, no bias, no conscious predispositions at all. It never blames, never criticizes, and never complains. There is no self, no self-consciousness, no memory and no meaning. It means more to an observer than it can to itself; its parts are busy operating at full capacity just getting the job done with a mere cubic centimeter of brain matter. There is no recall. There is no time for recall. Without recall, there is no time, no beginnings, and no endings.

The silkworm mechanically pulps some mulberry leaf. A bird overhead sees the silkworm, and recalls a meal. A human notices the bird; remembering and predicting what birds will do to silkworms, shoos the bird away. The silkworm mechanically pulps some more mulberry leaf, a living fiber manufacturing plant with no time for silly things. No time at all. It pulps some more mulberry leaf. No time like the present; no memory of the past, no hope for a future. The silkworm munches on.

Although overall increase in brain mass provides room for better memory and a more refined consciousness, it should be stressed that evolution has never equated sheer bulk with intrinsic value. If that were the case, we would all be under the rule of blue whales. Elephants have much larger brains than humans and they are still using their noses for hoses and working for peanuts. In terms of species, from an evolutionary standpoint, whales are closely related to seals. A very big seal isn't more complex than a small one; just more of. Likewise, there is a lot of whale to operate and everything is more-of including the mass of the brain. Much-more-of, but not better-than. Whale learning has been observed, and it seems to be at seal level, the aquatic equivalent of a smart dog.

This is enough recall for a sperm whale to dive down to where

it remembers the giant squids were. The squid, with less memory than a paper clip, never expected anything in its life, far less a large whale in the way. No matter how many pounds of neurons a giant squid was born with, if they're squid neurons it is going to be squid smart and no more. Squid nerves are like cables, so big they're nearly visible. Compared to that level of simple consciousness, even fish are savants. In this world, it seems, any species that can't remember will end up dinner for the rest. It was our last upgrade, the development of sequential recall and projection, which finally lifted us out of the present tense, our mental ascension in the evolutionary development of human consciousness.

Monkeys, Mutations, and Mindpower

How environmental pressures can affect brain growth in a primate was investigated by anthropologist Karen Milton, of the University of California at Berkeley, in a study of two kinds of apes. Apes have a diet centering on fruits and leaves. Fruits provide energy, but are low in vitamins. Leaves are high in vitamins, but require a long digestive tract to extract them. As a result, an ape with a shorter digestive tract must eat more fruit to make up for its inability to thoroughly process leaves. Since most trees bear fruit for only a part of the year, even in equatorial climates, this means that a fruit-eating monkey will need a more complex finding strategy in order to visit as many fruiting trees as possible in a given period of time. On the other hand, it doesn't take a lot of brainpower to find leaves in the trees if that's our main diet.

Spider monkeys and howler monkeys are about the same size, but spider monkeys are fruit hunters while howlers are leaf munchers. Although both apes weigh about the same, the spider monkeys are carrying around brains nearly twice as large as those of the howlers. The urge to avoid being eaten may have driven us into the trees, but once we were arboreal, locating something to eat, such as a tree in fruit, was the next environmental pressure. One of our most distinctive evolutionary steps was the rapid development of the forebrain's specialized ability to recall and redirect very complex search sequences, clocked and refined by the rapidly developing cerebellum. A fruit eating ape needs to remember and return months later, a task that favors recall and memory.

Under laboratory conditions, when a monkey starts to learn a task, most of the brain activity takes place in the parts directly

of the frontal or prefrontal cortex give rise to states characterized by 'loss of the future,' with consequent indifference, inactivity, lack of ambition, and inability to foresee the consequences of one's future behavior. It is concluded that the prefrontal cortex is responsible for the temporal organization of behavior and cognition due to its seemingly specific capacity to handle serial information and to extract causal relations from such information."

Analyzing results from tests on humans with damage to these brain areas, Goldman-Rakic obtained similar results. In some manner, the prefrontal cortex had expanded its ability to scan and manipulate memory into sequential projections. Now it was apparently back-loading them constantly into our waking consciousness, allowing us to include an ongoing prediction of possible futures based on information sourced from our vast memory. We take it for granted that we can think backward and forward, but it may be a unique gift. Without this predictive ability, our attention can't seem to get out of the present tense. In another study, neuroscientists P.J. Eslinger and Antonio R. Damasio described the dramatic changes in behavior of an otherwise highly intelligent man whose prefrontal area had to be removed due to a cancerous tumor. He continued to test well, but his daily activity was completely without internal direction.

"EVR" (the patient's initials) was not spontaneously motivated for action. As he awoke, there was no internal, automatic program ready to propel him into the routine daily activities of self-care and feeding, let alone those of traveling to a job and discharging the assignments of a given day. If these goals were presented externally and repeatedly, they triggered the expected actions. But when external recall mechanisms provided by relatives and friends failed, or when the environment failed to challenge him with situations that demanded a response, he resumed his relatively goal-less, unstressed existence."

"The prefrontal cortex can play this role," Goldman-Rakic had observed, "because of its elemental capacity to access and hold 'on line' information relevant to the task at hand. It seems possible that many integrated higher-order functions including language, concept formation, and planning for the future may be built on this functional element." Given sufficient memory capacity, the prefrontal cortex can "access and process information derived from present events and/or long term stores to guide a response over the period of seconds, minutes, and possibly hours required to fulfill the command." The brain's pattern sequencer had been located.

The most striking feature of this type of brain activity is that it provides the outline for what could be characterized as an ongoing neurological "slide show". A typical cruise missile is guided to its destination by moment-to-moment comparison of its GPS progress with a series of internal maps. It seems that our specialized prefrontal cortex acquired the ability to guide us forward or backward in time in a similar manner, by sequencing alternative patterns synthesized from memory. The crucial difference is that in a modern human, the search-and-predict activity has become an integral part of our waking consciousness.

This area of the brain is very recently evolved and would naturally mature after birth. Jean Piaget, an iconic figure in child psychology, described the stage in neural development at which a child watching a toy train enter a tunnel instinctively glances forward to await its emergence from the other end. Before that point, as soon as the train is out of sight, it's out of mind. Here and gone. The toy train's reappearance seconds later is unexpected and surprising. Another train? The mental train of thought had derailed back there when the actual train disappeared from view. This ability to predict was called "conservation" by Piaget, and it appears by degrees. By the time we are three we are aware of the passage of time, and we can finally wonder about tomorrow.

The childlike perspective of constant novelty in the world is unavoidable if we can't store and re-sequence our memory. The prefrontal cortex is the last to mature, so we must slide into our conscious chronology past the age of speech. By the age of four, however, we are experiencing time in our typical three-dimensional framework. Gradually we learn to take such a world for granted, transferring perceptions moment by moment back into memory, creating the illusion that time is moving forward. This may be how we perceive it, but it doesn't mean that time in fact moves in any direction at all. A more important insight is that the three great metaphysical questions could only be posed by a mind that sensed the passage of time, a gift that may be reserved for us alone. This leaves us with an obvious question. Do we create our own time?

The brilliant mathematician Norbert Weiner, whose concepts provided basic foundations for computer control, automation and artificial intelligence, posed a similar question in his seminal work *Cybernetics* in 1948. Weiner reasoned that if time were suddenly to shift into reverse, with planets circling backwards in their orbits, a space traveler arriving on the scene would detect no difference at the planetary level. Time might well run in both direc-

tions. However, it would be impossible for forward-time people to perceive a backward-time universe. For one thing, any stars going backwards in time would be drawing in light, not pouring it out. Weiner pointed out that it would be impossible to see such stars, given the way human eyes are made. Communication would be likewise impossible, since the conclusions would appear first, only to disassemble into totally meaningless parts as time receded. He concluded that the only sure thing we could tell about any universe we observed was that it obeyed the same laws of thermodynamics that we do. With the discovery of the vital role of the prefrontal cortex in the sequential arrangement and projection of time-tagged events, another obvious question emerges. If there is going to be a future sequence, why doesn't it simply appear to be our past in reverse? How do we create all the possibilities that appear? There must be a way to create new scenarios without adding anything from outside.

The answer is that if we are to transform our memories into future non-existent states, we must use abstractions to do it. All images of the future are formed this way, using abstractions to create new variations on real images from our experiential memory bank. But where do abstracts come from? Is it possible that pattern sequencing, in humans, may coincidentally serve as an abstraction engine, the ongoing source of the generalities we use to create our future projections?

In performing a chronological scan through patterns, we would be using the clocking capacity of the cerebellum to sort through many patterns, some containing a repeated aspect. Visual abstracts such as "red" might be the result of this scanning activity. Scanning backwards through images which contained first a red bird, then a red flower, and finally a red sunset, the "red" would register three times in a row, more perhaps than other parts of the pattern. If this happens enough times, a "red" sub-pattern itself, as a part of many other patterns, could self-generate, like an echo, creating a resonance leading to a new and independent pattern synthesized from this internal activity all by itself.

It must have created some extraordinary changes in the populations of early humans where this began to occur. *Homo Sapiens*' increase in brain capacity was spread over nearly two million years, but it appears it might have taken only a few small mutations to bring the image-sequencing activities of the prefrontal cortex into waking consciousness. As the largest and most detailed mental patterns on earth were shuffled in a regular and ongoing

manner, virtual information began to appear in the mind which was never sensed in the world outside. Networks grew in response to new patterns, and extended them into further synthetic patterns. Even as we filled our memories with a past that happened, we were assembling the elements for conscious abstractions, the crucial process leading to the prediction of any future that might be.

Many religions and philosophies contain hints that this may be the case. The Buddhist saying that the world we see is not a picture but a mirror speaks directly to this paradox of originality locked into the self-generated repetition of our own reflection in everything we perceive. Our final evolution was this transformation of time, as we learned to synthesize information derived neither from genetics, nor actual experience, but through the comparison of personal patterns sequentially juxtaposed in memory. As we project the image sequence forward, we find ourselves in what we call our imaginary future. We can reverse direction and think, "if only I had ..." We can reconsider, and in such reflection, we can be confirmed, or we may regret and we can learn. The word pagination refers to a sequential arrangement of pages; humans reflect and plan using imagination, sequentially arranging, altering, and projecting images from memory.

Automatic ongoing pattern sequencing can't occur in a computer environment because computer memories are reactive rather than active. Neurons are not chips, they are cells. Neither is the brain an immense computer lining up pictures like slides and peering through them. Each cell is alive and pulsing away, night and day. Most of this random muttering is too quiet for us to perceive consciously, but there is always a mental background hum. This continual chatter, a backdrop of constant activity, characterizes the mind at rest, the constant flickering of billions of energy patterns as our cellular chorus carries on the ancient tradition of mindless mental exercise, blending our incidental history with the present moment into the patterns we call thought and the experience we call life.

Waking Up in Africa

It didn't happen overnight. Over many generations mankind grew steadily more mindful. With climate changes, African hominids began to move out onto the savannas. Trees were scarcer and the heat was intense, but we'd learned that by standing up, we

hunting parties for larger game. Their campsites also revealed other aspects of their lives suggesting a largely day-to-day response to their world.

For one thing, males and females seem to have lived at a distance from each other and even eaten different diets. No small animal bones are found near the fire sites. It appears males only showed up when bones requiring heavy hammering or burning were brought back to the cave sites. Archaeologist Lewis Binford points out these are hardly civilized table manners. "This looks like we've got a situation in which females are essentially taking care of themselves much of the time. Fully modern man obtains food and brings it back. Then it's prepared and eaten by females. I don't think Neanderthals did that."

Furthermore, they were terrible planners. Every spring, rivers in French Neanderthal-land teemed with salmon, and yet there are virtually no fish bones in the Neanderthal caves. "They're not bringing the fish home, putting it in storage, and eating it out of storage," Binford continued. " Modern man plans months ahead of time; they move to places weeks before the salmon run. This all leaves a distinctive archeological record." There is no indication that the Neanderthals were lazy. They just couldn't plan anything past a couple of days, which severely limited their range. "Neanderthals simply didn't make it to the grasslands," concluded Binford. "To exploit the mobile herds of grass feeders, you have to know their behavior and anticipate it. Neanderthals didn't do that. They only lived where food was continuously accessible."

In the near future and the near past, there is time to toy with a bear skull or make a simple scraper, but we find little evidence of careful craftsmanship or planning. Whether a mentally childlike state is a blessing or a deficit is a good question, but a mind deficient in both time and abstraction will never be troubled with metaphysical questions. If the only answer to "Where did we come from?" is "From the cave, this morning," there is no need for a past with a purpose or a future with a plan. With memory out of sequence, abstracts could neither be conceptualized nor articulated. Wisdom would come slowly with age and "old" was anyone over thirty.

Our personal years from birth until three included a Garden of Eden for each of us, but it seems our brother species never got out of the woods. Gradual insight gained through experience would have been internal and inexpressible; wordless inspiration unshared and soon forgotten. Abstract concepts such as good and

evil were absent from the unmethodical minds of our northern neighbors. Traditionally, the faithful are certain God created mankind, while agnostics suggest that mankind has always created gods. The question really is "When did we develop an awareness that could conceive of God, and what step in brain development made it possible?" The answer is an abstracting and projecting chronological consciousness, and it seems appropriate that it evolved near a place we call the Holy Land. It was anything but a blessing for any other creature on earth, and especially for the locals. Cro-Magnon skeletons dating back ninety thousand years were found at Qadzeh in Israel. However, they found no Neanderthals skeletons in that area from later than forty thousand years ago. Neural upgrades don't leave fossil or bone remains, but while Cro-Magnon skeletons and artifacts continue on to the present era, the Neanderthals simply stop.

It seems we didn't limit our new mental technology to wiping out the local game. We used it to wipe out the neighbors too, and it took less time than anyone would imagine. In fact, if the St. Caesir remains are the last of them, it could have taken less than five thousand years. They were probably well entrenched when the Cro-Magnons arrived. Living in the temperate forests, European Neanderthals never imagined their most dangerous adversary walked on two legs. There is no question, however, that once the newcomers appeared in Europe things were going to get ugly."I see confrontation," says Ofer Bar-Yosef, an Israeli archeologist at Harvard University. "People who grow up in the Middle East understand that. We don't like each other. We rarely intermarry, and we kill each other whenever we can. I don't think you can prevent competition among societies." The arrival of the Broken Hill Gang was worse than invaders from space. They had the best tools, the deadliest weapons, and a real sense of interior decoration, judging from their cave paintings. They also brought curiosity, conflict, and chaos. They came from another Eden, and they took out the native Neanderthals in no time. The locals had no backup plans. In fact, they had no plans at all.

The young Cro-Magnon males had predicted the foraging female would return to where she'd been yesterday and the day before, searching for grubs, berries, or small game. It wasn't exactly like outsmarting a squid or ambushing wild cows, but it must have been easy to grab a Neanderthal. Like the older children in Piaget's study watching for the toy train to reappear, they waited quietly. She was nibbling grapes when they leapt from hiding,

converging on the terrified Neanderthal with weapons they had crafted weeks before in anticipation of future events. Now, in the thrashing present tense, they quickly subdued their grunting prey. They probably raped her; later they might slash and kill. It went on like this for centuries. In less than twenty-five thousand years, after millions of years of sharing the planet with any number of variants, we managed to carry out the brutal annihilation of every other human species on earth.

Wherever we found them, it was the end of the road. The only humans who could imagine a God had been given dominion over the earth, and we seized our promised land. The primitives didn't have a chance. They couldn't say a prayer, and they didn't have a hope. They were our brothers, strong and able, but unable to plant a garden or craft a killing tool. We out-planned, outsmarted, and out-bred them. Bearing in mind how we still treat our human minorities, we probably mistreated them, raped them when we could, killed lots of them, and maybe ate a few as well, perhaps with wild flower garnishes.

Modern consciousness may have been our birthright, but it was also their death warrant. For years, scientists argued whether any inbreeding occurred. Genomic DNA testing has given us the answer. They are still with us, dispersed among the very ones that drove them into extinction, mute testament to an unspeakable crime we can never forget. *Homo Sapiens Sapiens* became the only humans on earth: garrulous, upright, and stiff-necked; cursed with the mark of Cain for the systematic genocide of our last brothers on this planet. It is a curse we suffer to this day as we sacrifice our own in war and religious strife. Whenever we kill for the past or the future, we revive and partake in that fearful ancient legacy of premeditated fratricide — the original sin that only a fully conscious human could appreciate or regret.