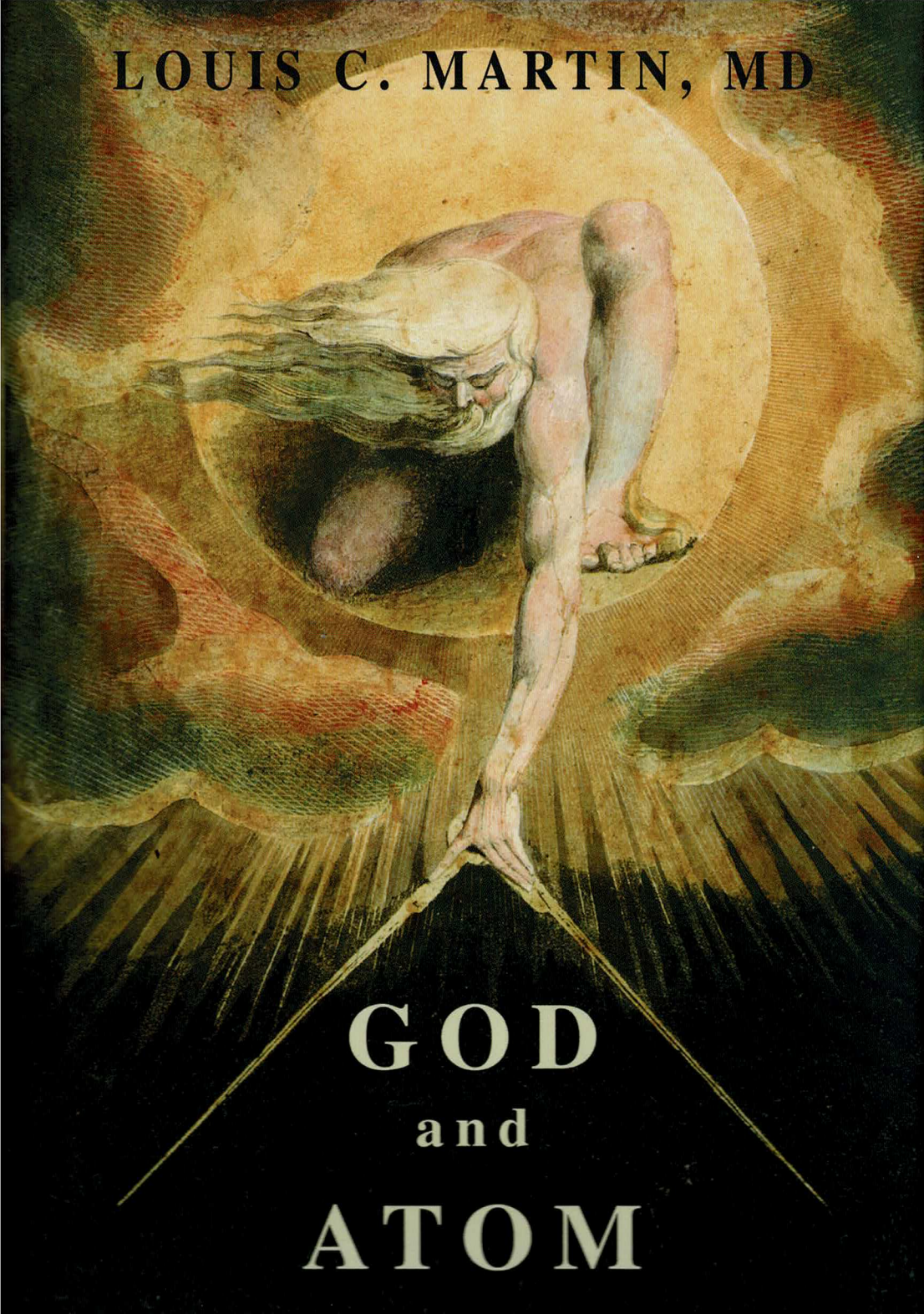
LOUIS C. MARTIN, MD



GOD and ATOM

Philosophy **$24.95**

Early in this new millennium, we are surrounded by an immense collage of things we have created, and things that Nature has presented us with.

Unparalleled wealth. Unparalleled suffering. Vast advances in medicine, information technology, and transportation. Genocide, war, a struggle between democracy and tyranny. Our systems of thought, value, and significance in the world more in flux than ever.

We could either blow ourselves up, or achieve for mankind levels of understanding and fulfillment beyond the fondest dreams of anyone living in previous ages. We can pollute ourselves out of existence, or we can husband the resources of our wonder world in ways that assure maximum benefit for the human family. Our mental and spiritual machinery presents itself in wild disarray. At times, it seems to be in shambles. The history of mankind's search for meaning and significance is a very untidy adventure. We are uncertain about the validity and place of religion in modern society and modern thinking.

This book is about as far as it could be from a scholarly effort. It covers too much ground to treat anything with the depth it deserves. But, these pages are based on the conviction that truth, though slippery, is not arbitrary. The universe is knowable, and our minds, though subject to confusion and error, are capable of knowing it.

We as a race have had two ways of knowing ourselves and our world. The first is through religion. The second is through science. That is a procrustean division, but purposefully chosen.

Our effort here is not to explain everything, but, rather, to pick a significant path through the thickets of human thought and experience throughout our cultural history. This is not an

GOD

AND

ATOM

Louis C. Martin, MD

---

psyquest.org

For further information, contact the author at:

Louis C. Martin, MD
psyquest.org
PO Box 541148
Omaha, NE 68154-1148
402-330-4635
email: martin@psyquest.org

Printed in Canada

Cover credit: Lessing J. Rosenwald Collection, Library of Congress.

Louis C. Martin, MD
God and Atom

1. Author 2. Title
Library of Congress Control Number: 2003099323
ISBN: 0-9748497-0-7

This book is dedicated to the Science and Religion project, and to all who are involved with it.

There is a particular dedication to Matthew and Julia and their families, with a wish for happiness and success in their own adventures.

Table of Contents

Foreword

When I was young, I expected that I would know everything by the time I was 40, and that the rest of my life would be lived in the enjoyment of the wisdom I had accumulated. Hah! Hah! And more hah! That's not the way the chess game of human life is played.

I have spent most of my life arm wrestling with the monsters of insanity, whether in the lives of our patients or in the society which juggles us all back and forth between convention on the one hand, and individual creativity on the other. No winner has yet been announced.

There is nothing in this book about psychiatry. The essay on the mind involves an understanding of the relationship between thought and the function of our brains, but even that is miles away from clinical considerations. On the one hand, the world of which we are a part is eminently intelligible; on the other, it yields up its mysteries only grudgingly. But, arduous and uncertain though the struggle has proven to be throughout history, progress occurs. And it is great fun to be part of the ongoing adventure.

A relatively new phenomenon is the Science and Religion Project, not a single effort, but a loosely organized movement comprised of thousands of individuals and a score of important organizations. Among the groups are: 1) The Center for Theology and the Natural Sciences (Berkeley), 2) Counterbalance Foundation (Seattle), 3) Metanexus Institute

(Philadelphia), 4) Zygon Center for Religion and Science (Chicago), 5) DoSER, the Dialogue on Science, Ethics and Religion of the AAAS (Washington). This list is representative, not exhaustive.

Over the last few years, I have found deep enjoyment in forging new friendships with men and women working in this vastly interesting and widely diversified movement. Human life has never had an easy shot at truth and significance, and in that respect our times are no different. Change in human affairs has never been more sweeping or more fundamentally unsettling. It is not easy in our complex society to find clear rallying points for value and spiritual focus. My recent experiences suggest that the Science and Religion Project is becoming a more and more important vehicle for spiritual and intellectual discovery and bridge building. Of particular personal significance for me has been the IRAS (Institute on Religion in an Age of Science) summer conference on Star Island. The personal associations I have made there and the long conversations I have had there have directly influenced the thoughts in these pages.

My gratitude is extended to all the friends, old as well as new, with whom I have jostled elbows in the trek into a challenging future, too numerous to mention personally. My special thanks to my wife Jane, who has kept the home fires stoked, at times bemused by my odd hours and abstracted thoughts. And to Matt and Julia, and their partners; my children and their interests have been an inspiration and joy. I have never been happier than during the hours I have spent with them.

Perforce I am more towards the end of this wild experience called life than the beginning. The calendar is an ineluctable master. All the past, however, is but an introduction to an evolving future, and subjectively I feel I

yet have long miles to go. What life will permit remains to be seen. I will continue to be grateful for whatever part I am privileged to play in our mutual unfolding adventure of cosmic exploration. Our wonder world, though our source of all knowledge, remains mysterious around the edges. Yet it beckons us on. The single summary truth is that any insight we achieve is but a reflected scintilla of that unbounded sea of existence and wisdom all men and women throughout the ages have spoken of as God.

Omaha, wintertime, 2004.

Louis C. Martin, MD

God and Atom

Tending the Cultural Genome

Chapter the First

Mundus Mendax

Homo Sapiens

The road to understanding is rocky. We have been walking around on our planet for 50,000 years, more or less, and you might think that by now we would have done a better job of getting the hang of it. Here it is, this wonderful organism called a human being, marvelously adapted to life on Earth through eons of evolution, with a larger brain and greater capacity to understand and to learn than any other of the beasts of field or forest, in an ecology that seems just waiting to be perceived and understood. One might have expected (unless he/she already knew a lot about our actual history) that progress would have been rapid, and that within a generation or two, at most, this very bright animal, which is us, would have got things figured out.

But, that's not the way it has been. Far from it. Our history has been strewn with outlandish ideas about our world and the whitening bones of far flung theories. Instead of a neat and tidy march from ignorance into the light of understanding, our past is clogged with thoughts about our

world which wouldn't work, and with theories that could not sustain their own weight. Our efforts at understanding our world have been uncertain and halting at best. We have had, time and again, to discard firm beliefs in which we had previously placed deep credence, and for which many of us would have been willing to lay down their lives. Many have indeed been martyrs for ideas we had later to discard.

It turns out that understanding our world is a far trickier task than any of us might have imagined at first blush. We have frequently been lured into making conclusions on too little data, and into thinking that conclusions or doctrines were more valid, or more lasting, than in fact they proved to be. It has been a faltering and sometimes painful walk from the darkness of prehistory into the light of understanding. And, getting all of this into focus and sorting it all out continues to be a thorny challenge. Not an impossible one, but a tricky and difficult one. One that is not over yet, in spite of all the advances we have made.

Faltering Steps

A thousand years ago most of us thought the world was flat, and that the sun, moon and stars were carried overhead on crystal spheres, the earth occupying a central and fixed position. We thought that things around us were made up of only four elements: earth, water, air, and fire. Most of us thought that God had miraculously made the earth and placed man and woman in it as fully formed creatures, the parents of a new and wondrous moral adventure. Those of us living in Europe thought that if we got in a boat and sailed west, we would fall off the earth and topple into an infinite and scary abyss below.

The advance of human discovery has been exponentially rapid. Comparing where we are at the year 2000 to a scant thousand years ago, we find that, in fact, much that we look back upon as quite ancient was still waiting to be discovered or developed. The fruitful flowering of the high Middle Ages, which we tend to look upon as long past, was still in the wings, waiting to come onto the stage of human events. The nation states of Europe were in their infancy. The great gothic cathedrals of Europe were not yet even concepts in the minds of the master masons who in time would come along to build them. Almost everything that we identify as current culture was yet to come.

Most events and discoveries which seem important to our lives have occurred within the last thousand years. And yet, as the world turns, a thousand years is but a stammer in the flow of cosmic time.

Even that doesn't do justice to the hurried pace of discovery. Let's not make it the last thousand years. The last hundred years, this twentieth century we have just completed, is an even clearer explosion in our struggle to grasp the shape of reality. The truth is that most things which we consider to be typically modem, those things which have made our current world of technological advance possible, have occurred within the last hundred years: atomic theory, radio, electronics, relativity theory, genetics, paleontology, space travel, and information technology. For those of us well down the road of life 's adventure, many of these milestone achievements have been novel in our own experience and memory. We have made great advances in technology and knowledge of the cosmos. Still, we don't have it right in terms of total understanding. If we think we fully comprehend the actualities and potentialities of our wonder universe, we are dead wrong. The problem is, unless we get some major problems figured out, and learn how

more appropriately to act and to husband the resources of the universe, we many in fact end up dead, wrong. Knowledge is power; it is also dangerous.

Embarrassment of Riches

We set to work on the process of discovery, built laboratories and universities, and filled them with specimens, complicated machines of discovery and piles of manuscripts reaching to the ceiling. Once we got around to developing a knack for science, the process of discovery went rapidly, and we surrounded ourselves with acres and acres of facts and vast stores of information. As far as knowledge about things is concerned, we have created an embarrassment of riches. But, our general theories about the universe and the meaning of our lives are still incomplete and uncertain.

We do not agree on how man came to be here in the first place, whether he was placed here by an omnipotent creator, arrived from another planet, or descended from the apes. There are many of us who are wholeheartedly convinced that the only things we can know with certitude are the facts of empirical observation. There are those firmly convinced that material things are the only things real in the universe, and that material existence is in fact the only kind of existence possible. As many believe there are spirits around us, and that the universe is created and ruled by a spiritual God. Many are convinced as a matter of theory that there are no general theories about the existence of things which make any real sense, and that the attempt to understand the world of reality in any exhaustive fashion is fantastical and doomed to failure from the start.

Given the apparent understandability of our marvelous universe and our own apparent ability to understand, it emerges clearly that our early hopes for comprehension were bold but superficial. The universe, though knowable, is a lot more complicated than our ancestors imagined at the dawn of history, and how to put it all together is a yet more daunting challenge. We have, at times, found our way into intellectual backwaters from which it has taken centuries to escape. We have mistaken appearance for fact, and have had, as often as not, to live for long periods of time either with falsehood or superficiality. Our first attempts at understanding our universe may have been exciting at the time, but turned out to be inadequate in the long run. Solid truth should wear well.

It is possible from current vantage point to tease out from the matrix of historical thought why it is that the road to comprehension has been so devious and difficult. First, the job turns out simply to be more complicated than once it may have seemed. But, it's not just that. Not only has the challenge been difficult in itself; it's worse. Mother Nature has been downright deceitful in how she presented herself! She encouraged us to believe things about ourselves and our environment that just weren't so. And, coming to an understanding of that can be a big help in comprehending how it is that the truth project has turned out to be such a very large order.

Even though the path has been stony and difficult, we do not want to abandon it. However obscure and unyielding nature has been, we still want to discover a saving path through the boneyard of our intellectual and spiritual history, and we want to come out on the other side with clarity and certainty hammered out of the welter of observations and theories we have amassed. We will continue to do that until we get things right. The old adage

suggests itself: fool me once, shame on you! Fool me twice, shame on me!

In Medias Res

Literary critics have pointed out since antiquity that epic poets do not present to us their creations as simple and straightforward narratives. Rather, the epic adventure begins *in medias res,* that is to say, in the middle of things, and then at a certain point there is a flashback which brings us up to date and makes the story complete. The *Iliad* begins with Achilles' anger while the Greeks are already encamped in battle before the walls of Troy. Only later do we hear of the stirrings of war on mainland Greece and the first assaults on the shores of Ilias. Vergil in his *Aeneid* starts out with Aeneas and his band of followers being tossed about in a violent storm on the Mediterranean. Later we hear of Troy's downfall and the departure of the defeated Trojans, setting out for their future home on the Italian peninsula.

On the larger stage of life itself, nature herself did a similar thing to us, by the very manner in which our racial origins occurred. Psychologically, nature started man's history *in medias res.* Our conscious history didn't begin with our actual origins, but with things as they already were far down the road of our development. We were not present, psychologically, at our own racial birth. Nature didn't just rearrange for us the order in which our understanding dawned. Rather, she rather deftly tricked us into thinking things were other than they really were!

The deception centered in this: when our ancestors became reflectively aware and began the development of a written tradition, which was necessary for the production of

structured thought and theory, the human animal was already a fully developed phenomenon, without an active recollection of our own history and origins. We never had the luxury of trying to understand the world or the human situation as a pristine phenomenon, uncluttered by the presuppositions or the partial truths which our forebears had fashioned. The only perspectives available to us were those from within the stream of a civilization that was already well under way.

Without civilization and culture, a comprehensive view of ourselves would have been impossible, but culture and civilization occurred far into the developing experience of the race. That is, *in medias res.* It could not have been otherwise. We can understand that, as we look at the human situation. What is not so easy to understand, in its essence and its repercussions, is the price we have had to pay for that quirky mechanic of evolving consciousness. Our cultural background has both sustained and limited us. We can never approach the challenge of understanding and discovery from a totally fresh and objective point of view. And there has been a price to pay for this.

Psyche: Aware at End of Process

It was only after our race had been around for hundreds of thousands of years that we began to develop anything like an objective sense of our true beginnings, and that very fact profoundly influenced our outlook on things. We continue to try to refocus the distortions introduced by that odd quirk of history. We wish that we had a more complete picture of our biological origins, in the sense that we wish that our family picture album were more complete. The preservation

of skeletal remains of animals, including early man's, is a chancy and uncertain business. Intentional burial came late in our racial history. The soft tissues of bodies under most circumstances decay very rapidly. Exceptions to this are quite unusual. We are dust, and unto dust we inevitably return. The chance of anything other than bones being preserved in the ordinary course of things is very small indeed, and conditions need to be just right even for hard body parts to escape decay and disintegration. Even bones don't come down to us from distant ages as bones, which themselves decay with time. Bones, when they are preserved, survive as fossils; i.e., their organic components need to be replaced by minerals from their immediate environment, and that will occur only under highly preferential circumstances.

But, the complex result of our biological fragility is we do not have a complete fossil record of our ancestors. Homo sapiens has been around for about 200,000 years, identifiably. The relationships between the Neanderthals and the Cromagnons are not altogether clear. But, what the best current thinking seems to suggest is that these two types of animals are sub-species of the same line which overlapped each other in time, but are probably separate. The oldest Neanderthal relics date from about 200,000 years ago. The Neanderthals lasted until 30,000 years ago, when they seem to have died out, for reasons that are poorly understood. The Cromagnons (who are us) appeared sometime after 100,000 years ago and were verging into dominance by 40,000 years ago. Did the Neanderthals die out because they lacked the competitive edge to survive? Did they intermarry with Cromagnons and gradually become absorbed into the more dominant population? Or some mixture of the two processes? We do not know, and may

never be absolutely sure, for the paleontological remains are too scanty for a satisfactory scientific investigation.

But, and this is hugely important, by the time Cromagnon strode hesitatingly onto the scene, we were biologically and developmentally pretty much as we are today. Our brain, which more than anything else defines our humanity, had developed to its current state of complexity. These remote ancestors of ours, who seem so far away from us in time, were equally as intelligent as we are today. Not much of anything has happened to our biological genome or physical brains since that time.

But, and that is a very large "but," Cromagnon at the beginning did not have the skills or the functional capacity to hand on the details of cultural evolution from generation to generation. It took hundreds of generations and many thousands of years for man to invent writing, and, until he could solidify his thought in writing, racial memory tended to be evanescent and unreliable.

Writing is a mystical and mighty invention. It is so much a part of our daily experience that we don't often stop to think about it, but the discovery of writing hurtled us forward along the path to progress in marvelous ways.

Human language can be broken down into its component parts. Simplifying, the basic individual sound is a phenome, roughly synonymous with a syllable in a word. Again roughly, there are only a few hundred phenomes in most human languages. These figures are not hard and fast; they are generalizations. In alphabetic language, a phenome can be represented by a consonant together with a vowel. Thus "ba," "po," and "el" are phenomes. There really aren't that many of them, although in some languages which are more difficult to represent in alphabetic script, such things as intonation and cadence come in to muddy the picture. It is likely that writing itself has had a reflex effect on spoken

language, encouraging a sort of consonantal precision where writing established itself early. But, that is a linguistic detail in which we do not wish here to become entangled. Where we are headed at this juncture is towards the fact that our ancestors learned to use an alphabet by which their entire language could be coded outside the body and outside current direct communication, thereby enabling the possibility of enduring incremental culture. This changed the entire nature of human existence.

Our alphabet consists of roughly 2 dozen little squiggles roughly representing sounds. There's still plenty of room for convention. But, by these 2 dozen squiggles we can express the entire vast range of our thought. A truly astounding convention! And, not only will an alphabet perform this function; it is also permanent and platform independent. As long as a piece of writing is carried forward in some form, its meaning is decipherable. It doesn't make any difference whether these little squiggles are chiseled into rock, cast in bronze or printed by a scribe's pen onto papyrus. The power of the squiggles is not in their physical structure but in their symbolic value. Like many great inventions, writing seems simple enough, once you get the hang of it, but it took 95% of the time since we appeared on life's stage to get around to inventing it. And since that time, culture has been explosive. Writing has been like a hot air balloon to our psyches, carrying us out of the particularities of time and place into the fresh air of a higher consciousness. Starting as a means to tally baskets of grain in a trading venture, it soon became a universal vehicle for the highest aspirations of the human spirit!

The world is an evolutionary place, as we will see. Once physiological evolution had produced us, with our extravagantly large brain, the significant vehicle for continued and rapid evolution was no longer the physical

genome, the double helix, but, analogizing, what we can refer to as the cultural genome, with its own set of codes and information transmission.

The cultural genome is that symbolized system of enduring behaviors, habits and ideas which made humans human, and which we pass on to each other, and from generation to generation. Other animals have a certain weaker kind of culture, but it is much simpler in its structure and much narrower in its scope. On our planet, human culture is the only culture achieving a *high* level of intellectual abstraction and the ability to store and communicate that highly specific sort of knowing.

Before the invention of writing, the cultural genome, by comparison with the lives of other animals, was creative and powerful indeed, but it tended to be relatively concrete and relatively unstable. Before writing, culture was limited by the power of human memory and to the relative durability of human artifacts. The past tended to be "recently" or "a long time ago." A lucky youngster might know his/her grandparents, but that span of half a century or so was, generally, the conscious circle of cultural awareness. The long past got distilled into mythologies rather than into either chronicles or history. In this sort of human life, there could be a considerable amount of lore about farming, hunting and the mysteries of human generation itself, but that tended to have an indifferent permanence and quite fuzzy edges. And, more significantly, the cultural genome before writing could not sustain that specifically human struggle to figure out truth about the universe.

Memory Not Carried Forward

By the time our ancestors achieved a level of culture when they could be reflexively aware of themselves and their surroundings, in a way that was solid enough to build on, they did not carry with them an active memory of the steps it had taken them to get to where they were. It was as though they had been popped into existence without a history and a provenance. Very strange. But, built into the very structure and nature of emerging intelligence. The only accounts available to our distant ancestors to explain their origins were mythological ones. The race may have sprung from dragon's teeth sowed by a mythological hero. Or, more tellingly, as far as later history was concerned, by God's forming Adam from the slime of the earth and breathing life into his nostrils. The question in what sense the external world manifests or embodies intelligence is a very real one, but not one we had the luxury of approaching in an uncluttered or unbiased fashion. We have always looked at the problem through mental spectacles tinted one way or another by the generalizations, frequently with considerable emotional impact, of mythology. This has left us with a considerable problem of keeping things clear and in focus.

This distortion was built into the nature of human experience itself, and not just the result of chance or stupidity. This is why our world, our cradle and our home, the source of all knowledge and understanding, nonetheless comes to us as *Mundus Mendax,* the deceitful world. A byproduct of the way evolution, and then cultural evolution, had to occur was that the only option left open to man to explain his appearance was a mythological account rather than a realistic one, since, lacking writing in the early phases, he had no way of recording and carrying with him

what was factually occurring. Our ancestors sailed onto the sea of reflective consciousness with a mythology rather than a true history. And this implicit mendacity of experience profoundly affected, and, in fact, continues to affect, the stream of human culture and man's difficult endeavor to understand himself and his place in the vast adventure of an evolutionary universe. The tricky universe bamboozles us still.

Lie number one told to us in our cultural infancy by mother nature was that we sprang from mythological origins!

Underpinnings Obscure

There's another kind of dissimulation that Nature perpetrated, equally as important as the first. This second “lie” told to us by nature was that things pretty much are as they appear to be, and can be adequately understood on the level of immediate observation. This has to do not with a human ability to record his own history, but with the fact that the observable universe is definitely not as it seems. It took humans hundreds, in fact thousands, of years to get to the place where they realized that just about everything, but living things in particular, have to be cut up, teased apart and looked at with special instruments if they are going to be understood with any degree of adequacy. But, at the beginning of the inquiry, the mind-set had not been developed which saw animals, much less man himself in this light. And, further, the instrumentation and technic were not available, either, when humans began to study living things seriously. Compound microscopes were invented only in the 17th Century, and have continued to be perfected since then.

But, the upshot of this part of the picture is that the underpinnings of life were not at all evident at the time when writing finally was invented and humans were able to set seriously about the task not only of describing, but effectively investigating the substructure and underpinnings of the appearances presented by living things.

Aristotle was as intelligent and as curious about the universe as any scientist has ever been, and he left voluminous writings on broadly diverse topics: classification of marine life, the surface physiology of animals, the nature of matter, ethics, politics, literary criticism, and metaphysics. It is a bit hard to identify any category of things in which he was not interested, but the scientific method it would take to develop a comprehensive biology, and the instrumentation required to pursue such interests, were still thousands of years in the future. Given his times and what they offered him by way of scientific method, he simply could not get to where even Louis Pasteur was in the latter part of the 19th Century. And Pasteur's insights would have to be classed as primitive compared to where we have gone with biological understanding since his time.

Nature started out deceiving us. We set sail on the sea of discovery with false ideas about the nature of the activity. And, unless we understand this, and how it has affected the pursuit of truth and understanding, there will be many turns in the road to knowledge which we will misidentify. Our ancestors were not stupid, but their place in the space-time matrix caused them to make erroneous observations and conclusions. But, two things: 1) that does not mean that they were not on the road to discovery; we would not be where we are had they not taken the steps they did, and 2) that does not mean that they did not enunciate some truths about the universe which are shrouded in the mélange of their theories

and observations; another dimension of the search for wisdom is being able to tease out enduring truth from matrices which may involve significant misinformation or downright error. But that is the nature of the quest. This constant resifting and reevaluation of evidence is a continuing process. Where will it end? We do not know. But it is only fair to observe that, as far as the comprehension of cosmic processes is concerned, we haven't been at the project all that long.

It is characteristic of intellectual maturity to recognize that knowledge is partial, and that we are still *in via* as far as the adventure of discovery is concerned. We have had through history a tendency to invest the mental and spiritual systems we have developed with a quality of permanency that they did not really have in themselves. We like to think we have lasting solutions rather than emergent perspectives.

Exhaustive Understanding

How many tiers are there in possible understanding of the universe? We do not know, but we do know that we are not there yet! But, over the last few centuries we have learned marvelous things about so many areas of reality, and have corrected a great many mistakes and misconceptions about the universe we inhabit. How much farther is there to go, and what opportunities will open up to us which we cannot foresee at the present time? And, how will we tie all of this into our spiritual traditions? Great questions, with emergent responses rather than definitive answers!

There are many reasons for believing that the universe is finite in its intelligibility. There are still many nooks and crannies on our home planet which are only partially

catalogued and understood. The diversity of life forms has proven to be almost astronomical in its variety and its numbers. But, even that is not infinite in its quantity and extent. But, in one sense, it is probably not meaningful to work out and record all the minute variations which exist in life forms. It is valuable to learn the basic structures and processes of classes of life process.

It is a different kind of problem when we turn away from the proliferation of individual variation and fact, and focus on the basic building blocks and processes of the physical, non-living universe. Over recent time, we have made large inroads into understanding the structure and processes of inanimate nature. We know the number of possible species of atoms, and we have delved deeply into the number and nature of subatomic structures and functions. And though we are puzzled with the indeterminacies of quantum mechanics, we understand much about the basic physics which underlie the phenomena of macro-existence. Looking outward, we have learned a lot about matter on a cosmic level. The mysteries of the stars and planets have largely been disclosed, and the mathematics of the greater cosmos have become increasingly clear.

Our objective knowledge of the nature and structure of the universe is very new — most of it was discovered during the twentieth century. It is true that there are still very substantial problems about the universe, but our advances have been, all things considered, very swift and very extensive. Is there an end, or a relative one, to discovery and to understanding? We do not know at this time. Certainly, history is replete with opinions by important thinkers that we have learned about all there is to learn, and that novelty in the universe has worn off. In the early part of the 20th century, Neils Bohr, the great physicist who invented the planetary model of the atom, felt that we had gone about as

far as we could, and that there wasn't that much left to learn. How wrong he was! Looking back, we realize that Bohr was at the early end of physical discovery, and that he had just pushed the door a bit open. He was at the antechamber of physical understanding rather than within the inner sanctum.

But, how far can we go beyond where we are? Is there an end to discovery? And, perhaps even more significantly that that, what difference would it make if we did reach an end to the complexity and comprehensibility of our universe? Would we then be able to turn to other forms of productivity, and what would they be?

At present juncture, we can only speculate about these sorts of problems, but the mystery of the future continues to beckon us. Fact has not been exhausted, and how to fit fact into the framework of philosophy and religious belief is yet more obscure and uncertain. We wonder, rightly enough, what is the ultimate place for intelligence and consciousness in the universe. What the last few centuries have taught us in terms of the discovery process is that things move faster than we might consider in prospect. The future will be on us before we know it, and we had better understand it and its implications, as much as we can. The future becomes rapidly the continuing present.

Chapter the Second

Cosmos I

A Tale of Two Cosmoi

Historically, as a race, we have looked at the world in two markedly different ways. The first of these is philosophically; the second is scientifically. These are not clearly demarcated from each other. But, approaching the knowledge endeavor as though they were can help us understand the human experience. This is a productive way to generalize about our history and our current outlook on ourselves and the universe in which we find ourselves.

There is value in using such an approach, but, having at the beginning of our journey set things up this way, we need, before heading off merrily down the road, to acknowledge at the onset that this does a certain amount of violence to history. It implies a compartmentalization that reality does not exhibit externally. Raw reality is a good deal more intermingled.

The problem about human thought is that we cannot say everything at once. The only way we can get our minds around complicated things is to break them up into pieces, and to consider those pieces one by one. After we have done this, we can then put the pieces back together and view the panorama.

So, for the sake of simplicity, let us say that there are two ways of looking at the world: philosophical and scientific. And, by philosophical here, I include religion and theology. This is not consistent throughout these pages. There will be other contexts in which religion will be opposed to philosophy, rather than lumped in with it. But, the difference will be clear from the context.

In ancient days — during the mythological period of Greek history — the story was told of a rather unpleasant fellow by the name of Procrustes, who lived in Attica near the town of Eleusis. He was a robber by trade, and would lure hapless travelers to his home by promises of food and lodging. He would then achieve his nefarious ends by fitting them to an iron bed he possessed, either cutting them down to fit his furniture if they were too tall, or hammering and stretching them to size if they were too short. Not a very pleasant host, indeed! But, hence the figure of speech of being made to lie in a Procrustean bed.

Dividing our historical development, then, into a philosophical period and a scientific period is grantedly a Procrustean venture. But, I am doing more than our prehistoric highwayman was wont to do: I am telling you about this beforehand, which most certainly he did not. Forewarned is forearmed, and I want you to recognize the weaknesses as well as the strengths of this approach. As we move along, we will straighten things out.

With such a caveat, then, we will say that there have been two broad ways of looking at things in our culture, and we will name them Cosmos I and Cosmos II. Our story then becomes a Tale of Two Cosmoi, to knock off Dickens. And, it is a story that we continue to write. The adventure of discovery continues.

Set-up for Misperception

We arrived on the stage of reflexive comprehension with intellect and the language to express it fully developed, but factually impoverished, because of two things: 1) not having carried along an active memory of our own evolution, and 2) not having an understanding of the structure and mechanics of the universe we inhabited. Written language took a long time to develop, and scientific knowledge even longer. Those facts are part of the overhead of being human, and something similar or analogous quite probably could be identified if we knew anything about the evolution of intelligent life anywhere else in the cosmos.

Quite likely, these are aspects of an evolving intelligence, and, quite likely, if we can prescind enough from the particularities of the situation, we can see that problems such as these are intrinsic to the human condition.

We see the early systematic thinkers of the race struggling mightily to understand their situation, without knowing consciously the intrinsic complications of the situation they were dealing with. They were trying to clamber out of a deep pit of ignorance, without an active realization of their position. They could see the walls of the pit and the light above, but because of where they were coming from, they could not get the lay of the general landscape.

But, at the beginning, they finally developed writing, and that enabled them to solidify their speculations and theories, and to establish a base for continuing discovery. Equally, the written word would serve as a foil against which other thinkers could test their own mettle. Discovery occurs only in the minds of individuals. Yet it is a most actively social activity. The interplay of one thinker against another is

critical to the process. Create a theory and others will utilize it for whatever insight it gives into phenomena; they will also criticize whatever shortcomings they find. They will go on to make yet better hypotheses and to enunciate better insights, thus to contribute to the ongoing quest for truth. That is the way we learn.

Giants

The world is a far-flung place. We have achieved a level where, if we need to do so, we can fly around it in a day or two. If we do that, we look down from our momentary perch, 35,000 feet up in the air, on a broadly differing panorama of peoples and countries. As we make this journey, which is one now repeated hundreds of times by thousands of people during each 24 hour period, a downward gaze would scan over a kaleidoscopic mélange of terrains, climates, and human conditions. This is a richness of observation unknown to earlier generations, unless by imagination. Consider the mythologies of flying carpets. But, each epoch in human history has had its own problems, and its own limitations and strengths, in its effort to deal with and to understand the total surround in which it occurs.

The constant in this complicated adventure which has stretched over the last several thousand years is man himself (herself). What has changed is the incremental and ongoing heritage of the race. There is no indication that over the time frames of recorded history human nature, or human intellectual capacity, has changed in the least. The evidence is in fact quite to the contrary. The humans who built the pyramids, or who wrote the heroic poems of the Trojan War, were the same humans, exactly, as the humans who, in

current time, perform heart transplants or jockey space shuttles beyond the binding shackles of cosmic gravity.

The ancestors of early man first differentiated from a common primate ancestor around seven million years BCE. “Lucy,” an australopithecine, who has gained widespread notoriety because of the exceptional completeness of her skeletal remains, dates from around 3 million years ago. Our cousins the Neanderthals walked on life's stage from 200,000 years ago to 30,000 years ago, by best estimation. Cromagnon, named for a cave in the Dordogne region of southern France, came to flourish an estimated 40,000 years ago. Of the hominid line, Cromagnon is the only species to have survived — for they are us.

There is no evidence to support the idea that there has been much, if any, biological evolutionary change during the ascendancy of Cromagnon, or *homo sapiens sapiens*. There has certainly been change in the phenomenology of humankind since the cave paintings of Lascaux, but as far as we know that change has been cultural.

Contributors to the human experiment throughout the ages have recognized that their work depended on their cultural forebears. The comment has been attributed to several thinkers from different periods that the reason they have been able to see so distantly is that they have stood on the shoulders of giants. The history of the race is the repeated story of great leaps forward in thought and discovery, but in a connected way. The advances of geniuses have been prepared for by those who have gone before, yet their bold discoveries have been inexplicable in terms of their precedents. Progress has been connected, but characterized by leaps rather than by gentle growth. That's part of the mystery of mind.

What happened during the 200 years from 500 to 300 BCE in the relatively small community of Athens on the

Greek peninsula was a brilliant set of mental experiments which hurtled human endeavor forward by remarkable stages.

This flowering of course was not without its identifiable antecedents. Trade had flourished in the eastern Mediterranean for hundreds of years, encouraging the development of writing and record keeping. To the south, the Egyptians had built their vast monuments, utilizing sophisticated geometrical calculations. To the east, philosophical systems had been constructed, and astronomers had described the majestic sweep of stars and planets in the heavens. Babylon and Assyria had established for passing periods the structures and machinery of empire. The Greeks profited directly or indirectly from all of these.

But the development of the Greek schools of philosophy and science represented a qualitative and quantitative advance, laying the intellectual foundation for everything that has developed since.

Outstanding among the many intellectual adventurers of those times were, of course, Socrates, Plato, and Aristotle. We are not here attempting a complete recapitulation of western philosophy. That has been done elsewhere, and by others. Our interest here is to mark both the continuity, but also the remarkable forward leaps, of the human mind.

Socrates described himself as a gadfly to the Athenian people, asking painful questions which presupposed objective truth as a transactional commodity. Plato tried to account, on a generalized level, for how things are constituted, and how they might have come into existence in their current manifestations. Some have commented that the entirety of later philosophy is but a series of footnotes to Plato. Truthfully, that is a condescendingly dismissive statement, which misses broadly the developmental nature of cultural evolution, but it underlines how powerful were

the Platonic speculations, and how important a position Plato holds in the evolution of human thought. Aristotle was remarkably prolific, interested in a broadly diversified range of subjects, and a powerful organizer.

No single human being has done more than Aristotle to advance the project of systematic understanding and to give shape to intellectual endeavor. He invented the science of formal logic. He wrote about mollusks and other forms of marine biology. Ethics as an intellectual science rather than an exhortative exercise was Aristotelian in origin. His metaphysical speculations about form and matter gave structure to investigation for 1500 years and more, and continue to exert their import and influence to the current day. To an extent, it has been unfortunate how difficult it has been for thinkers to grow gracefully through the structure of Aristotelian theory, but later advances would never have occurred as they did without the Aristotelian stimulus. Aristotle's view of the material world represented a quantum leap forward, although it also served as a trap which hindered for centuries the efforts of further advance.

A precautionary note. We are making an effort to place the evolution of human thought in a comprehensible context. Western thinkers and their achievements loom large in this account, not because that is all there is, but because that is my own locus in the intellectual and spiritual stream. To the extent that this does disservice to thinkers in Eastern traditions, an apology would seem to be in order. There has been constant interplay between cultures. Other linkages and influences could be emphasized, but that is not the primary objective of these pages. These perspectives are quite admittedly more heavily influenced by Western culture than by other traditions. Others are free and encouraged to add their own richness.

Jesus Christ

Our purpose here, then, is to recognize the developmental organicity of culture, and to present in outline major significant elements. We are, in these pages, in pursuit ultimately of larger game, but that venture would be an impossibility without some identification of high-water marks left by our mental ancestors. We are in this venture together.

A central figure in human culture, particularly in the West, has been Jesus Christ. Whatever we want to make of him and his influence on the world, there is no escaping the fact of his pivotal importance culturally and historically. It is absolutely impossible to understand Western history, and therefore our current world, without understanding a good deal about Christ and how his life and person impacted the course of events. Christianity became the dominant theme in culture for 1500 years and more, from the time of the Roman emperors until Galileo started looking at the stars and planets through new lenses and a new mindset. And the interplay, the interface, between science and religion continues to be a dominant and structuring dynamic. This is not a particular doctrine. It is an observation on the way the world has been and is.

The Glory that was Greece and the Grandeur that was Rome

This famous line is from Poe's lovely poem *To Helen.* He felt inspiration from classic times, and encapsulated his admiration in these tender phrases:

> "On desperate seas long wont to roam, Thy hyacinth hair, thy classic face, Thy Naiad airs have brought me home To the glory that was Greece And the grandeur that was Rome."

It is natural enough to compare these civilizations, since it was through their conduits that thought and culture passed to the Christian world, which in tum became the fertile birthing nest for our own time and civilization. In that sense, and to the extent that we have been affected by our history, we are all Greeks, and Romans, and Christians too, however much we try either to support or repudiate our history and our birthright. That birthright in modem times has been further enriched by the globalization of culture. The civilizations of India, China and all other countries flow together in current time to make the amalgam of the modem world. But, we cannot understand ourselves unless we understand to some extent the sources of our beliefs, attitudes and prejudices.

By the first century BCE Rome had extended its power throughout the Mediterranean and its adjacent lands. There were insurrections certainly and wars, but there was nonetheless a remarkable solidarity and bureaucratic organization which lasted a full 500 years from the time of Julius Caesar 's crossing of the Rubicon in 49 BCE until the defeat of Romulus Augustulus, the last Western Roman Emperor, by Odoacer, the chieftain of a Germanic tribe serving as Roman mercenaries (476 CE).

The Romans have justly been famous for their organization and technology. The ruins of Roman architecture are spread throughout Europe, from the Italian peninsula itself 28 to France, Germany and the British Isles. They were great engineers, capable of throwing bridges over the Rhine and building immense fortifications, the likes of

which would not be seen for another 1000 years. That in itself did not entail abstract speculation about formal or final causes, but the underlying subtle powers of Greek philosophy and science were never far distant from the Roman mentality. Greeks served as teachers and educators to the Roman elite, and a knowledge of the broad outlines of Greek thought was as much a part of the educated Roman as was familiarity with the policies and regulations of the structured bureaucracy.

Rome's leading orator and statesman, Marcus Tullius Cicero, was a prolific writer and apologist for liberal education. In addition to the many political and juridical speeches he left us, Cicero also wrote several scholarly essays on philosophical and moral topics: the *Tusculan Disputations, On the Soul, On Old Age, On Civil Duties,* and *On Friendship*. These treatises, though lacking the imaginative creativity of the original Greek thinkers, were, nonetheless, interesting writings considered in themselves and adequate mirrors of the Hellenic philosophical thought which inspired them.

Organizationally, Rome created by its institutions and presence as well as its writings a wide establishment of governance and civil society. The Romans successfully developed and maintained for centuries the rule of law and a sense of imperial structure. These cultural elements were novel achievements, and continue to influence our thoughts and feelings about the way that the world can and should be.

The Jews

It was into the world of Roman governance and rule that Jesus Christ was born, and at the hands of which he eventually lost his life.

Jesus began his life in one of the eastern provinces of the empire, a fractious and frequently turbulent one at that. By birth and station, Jesus was, therefore, a member of a subjugated people. As such, although his place of bi1th was but a flight distant, by modern standards, from the capital of Rome, his origins were markedly different from those, for instance, of Cicero.

Jesus was born into a cultural stream that was politically and militarily subordinate to Rome, but of considerably greater subtlety and antiquity. The Jews as a people had solidified their identity from the middle of the 2nd millennium BCE. What held them together as a people more than anything else was their Book, the collection of tribal writings which defined to them their national character, their history, and their mission.

Other nations and cultures had their gods, to explain the forces of nature and to symbolize and ritualize the pivotal crises in human life. The Jews had concluded that godhead in the universe was unique, and that the many gods of the "gentiles" were idolatrous and false. The God of the Jews was external to the visible universe, and the cause of the material world which we see and are a part of. However, though God was external to the universe, he was not distant or impersonal. Quite the contrary, he was intimately concerned with the history and destiny of the Jewish nation, and personally intertwined with the daily lives of his people. The God of the Hebrews was not a philosophical conclusion, reasoned to in a way that might have appealed to the Greek mentality. Rather, he was a direct religious conviction,

requiring no intellectual defense beyond what was evident in the matrix of immediate experience. The Jews felt they had a particular destiny under the protection and direction of their God; theirs was to be a special people, with an unfolding history and racial experience intended by God, and supported by his strong arm.

Into this strongly religious and strongly theistic culture Jesus was born. As a young man, he was raised as a faithful child of the tribe, sheltered by the power of God and living within the spiritual shadow of his temple. According to the Gospel story, Jesus as he came into his manhood separated himself from society for a while, retreating into the desert and wrapping himself in prayer. Those forty days were powerfully formative for the young Jesus. He returned having met both God and the devil, and convinced of a special mission and destiny. He entered his public life, a period during which he preached and talked to people about God and about the coming of his Father's kingdom. Ultimately, he was seen as a political threat by the Roman governor, and, with the leaders of the Jewish people urging him on, Pontius Pilate, the Roman, had Jesus executed.

Thus is Jesus portrayed in the Gospels.

Christianity

What occurred after the death of Jesus could not have been predicted. It took only a brief time for the vision of Jesus to develop traction first among the Jews themselves, and, not long after, among non-Jews from various mid-east peoples, and then among the Romans themselves. Once the young religion became established, it spread with amazing rapidity. There had been other religious prophets, and other mid-eastern religions. Mithraism and Zoroastrianism

developed limited followings, but these were soon and powerfully overshadowed by the way that Christianity established itself, both in individual conviction and also in institutional structure.

The claims apparently made by Jesus were unusual and transcendent to ordinary experience. He felt himself to be a special Son of God — possibly even God himself, though his ideas were not developed in enough detail for us to know exactly what he meant by the enigmatic statements that have been reported. But, if the evangelist is to be believed, Jesus proclaimed himself to be "the Way, the Truth, and the Light." The God of the Jews was claimed as his Father by Jesus, although perhaps not exclusively. He taught people to pray, "Our Father" — the progenitor and protector of the entire people. Jesus envisioned a spiritual kingdom, the rule of his Father, to which all men were called, and which all men could achieve through spiritual awareness and integrity. He encouraged purity of heart, freedom from attachment to worldly goods, and forgiveness of the wrongs done by people to each other. Just how his vision was to come about, and what it might mean in terms of social and political reality was never made explicit in the teachings of Jesus. History would clarify how men would interpret the Master.

Jesus was a Roman subject. He taught that we should render unto Caesar the things that are Caesar's, and unto God the things that are God's. We do not know what ideas Jesus entertained about how his kingdom was to relate to the empire of Rome. He was a moralist, not a political scientist. When brought face to face with the Roman procurator, he claimed that his kingdom was not of this world. John the evangelist puts these words into the mouth of Jesus: "If my kingdom were of this world, my followers would have fought that I might not be delivered to the Jews. But, as it is, my kingdom is not from here."

It is not our intention here to decide on the nature of Jesus, nor the ultimate meaning and value of his message. We are interested in understanding the effect Jesus and his message had on the world into which he came. His pronouncements were totally foreign to either Greek or Roman mentality. The remarkable thing is, however, that the personality and ideas of this obscure teacher from a laboring background came to dominate, after his death, the very culture which executed him. An outcome that no one could possibly have predicted.

The Other World

The Roman empire in its day was by far the most powerful and politically successful entity that the world had ever known. At the time of Jesus ' life, it held sway from Gibraltar in the west to the Tigris and Euphrates in the east. Roman might and Roman law were in command. When Saint Paul once was threatened with scourging, he was able to hold at bay that dire penalty by claiming, “I am a Roman citizen.” As is true with any large political and bureaucratic regime, there was a depth of dishonesty and corruption in the Roman system. Governorships in the provinces were seen as opportunities to tax and plunder. Typically, after a term of governorship was ended, a Roman official could return home with coffers full, and a life of future luxury and wealth guaranteed. In that sense, Rome was no better than any other tyrannical system of government. But, at the time, no one doubted Rome's power or stability. The idea that it should in brief time be penetrated with the religious teachings of a man put to death by the state in an obscure province would have seemed preposterous, had it even occurred to anyone.

By the time Jesus walked onto the stage of history, the intellectual work of Plato and Aristotle had been accomplished. The mathematics of geometry and engineering had already been developed, and were part and parcel of the education of the elite. Military planners and civil architects were capable of erecting fortifications and aqueducts which in some instances have endured until present time. On several fronts, the teachings of Jesus Christ and his followers were directly antithetical to the spirit and ethos of the Roman empire. Nonetheless, these highly disparate elements were mixed together in the cauldron of history, with an outcome of surprising diversity, energy and richness.

The otherworldliness of Jesus was introduced into the very effective thisworldliness of Rome with marvelous and enduring results.

During the first years of Christian scholarship, there were intense arguments about how to adapt the ideas of Christianity to the philosophical ideas of nature and causality which had been developed during the preceding 500 years by Greeks and Romans. What was the nature of Jesus? Was he god or man? Did he have two natures or one? What was the nature of grace? What did salvation mean? How could there be three persons in God? Or, what would that mean? While the teachings of Jesus spread throughout the minds and hearts of ordinary people, the intellectuals thought up every theoretical concern possible. And many of these were settled by less than Christian methods. More than one council of the growing church was settled by fisticuffs or worse.

Augustine

It is always tempting, looking back, to wonder why people didn't do things differently than history records. Why did subjects of the Roman empire take the intellectual turns they did? Why did they not take other paths through the intricacies of evidence with which they were presented? Why was it that the early Church emphasized so strongly the spiritual aspect of things? Why did they not pick up more on the empirical studies of Aristotle, or the mathematical theories of the Pythagoreans? They might have, but if they had, later civilization would have been much different than the history we know.

The rational and philosophical achievements of the Greeks intermingled with the spiritual and morally compelling concerns of Jesus Christ and his followers. Ethical and theological concerns came to dominate the mentality of Europe for a millennium and a half — from the time of Jesus until interest in classical humanism kindled anew during the Renaissance.

Augustine of Hippo, who lived during the 2nd half of the fourth century and into the early years of the fifth, powerfully exemplified and influenced his time. He drank deeply from the wellsprings of the cultural world in which he found himself, became learned and a scholar, and did as much as anyone to guide and form the intellectuality of a developing Christendom.

Augustine was born in Tegaste in 354 CE, in what would today be western Libya, the son of a pagan father and a Christian mother. From boyhood he was given a good education, receiving training in classical rhetoric. Reportedly his youth was tempestuous; he seems to have sowed his full share of wild oats. At least his later life was scoured by the pumice of reflective guilt. After youthful years in Africa, he moved to Italy with his mother, Monica, continuing his teaching. In Milan, he was converted to

Christianity by Saint Ambrose, then bishop. He flourished in his new-found religious home, and after further adventures, was raised himself to episcopal status, serving as bishop of the North African city of Hippo from 395 until his death in 430, during a siege of the city by the Vandals.

Augustine was a man of tireless energy. In addition to his teaching, and, later, pastoral work, he became a prolific and powerful writer, devoting his efforts and talents to the defense and further development of the still young religion. It is hard for us to recreate the polemic and unsettled atmosphere of the times. Augustine was not an armchair theologian. He was very much an active apologist and vigorous champion for what he considered to be proper orthodoxy against heretical opposition and continuing pagan influence.

In all, he produced a small library of works. The most widely read was his *Confessions,* a moving account of his spiritual quest and a literary work in itself. His broadest and most solid theological work was his *De Civitate Dei,* or the *City of God.*

Civitas Dei

In *City of God,* Augustine structures a bold project for himself, based on a specifically Christian perspective on history. Augustine's early years had not been that different from those of many other strip lings in the extended Roman empire into which he was born. Though there was much that was great and powerful in the Roman ethos, it was by Augustine's time tottering and corrupt. In the midst of this cultural dissonance, Augustine developed a restless thirst for value and truth. And, at a highly formative point in his young life he came under the influence of bishop Ambrose

at Milan, who himself was a devoted and learned champion of the growing Christian faith. The two largest factors in Augustine's life, then, turned out to be the Empire, on the one hand, and the Church on the other. Church and Empire seemed to Augustine to be opposed to, and in competition with, each other. Faced with contradictions in his own personality and in the social world around him, he struggled mightily to weave the elements of life as he knew it into an intelligible system: the result was the contest between the earthly city, exemplified in Rome; and the heavenly city, exemplified in the Christian Church.

Looking back, we tend to wonder whether the development of the Christian world view would have occurred without men like Saint Augustine. That is something we cannot choose now, since what happened is a matter of the immutable past. Right or wrong, Christianity introduced a highly spiritualized outlook into Mediterranean culture. If we think that maybe it would have been better had events developed otherwise, it is a balancing consideration to realize that it was precisely this mixture of spirituality and practical rationalism which fueled the impetus into the world of modem discovery and invention. The successes and failures, weaknesses and strengths of the Christian church are a part of our cultural heritage, and continue to influence our patterns of thought and society today.

Coming into the intellectual stream of Europe when he did, there were certain presuppositions which skewed Augustine's thought from the beginning. *Mundus Mendax* at work: being faced in the stream of things with man as a finished phenomenon, without an active memo1y of how he got there.

The most pervasive structuring theme in Augustine's thought is the acceptance of Sacred Scripture, the Book of the Jews, and the modification of its message through the

life of Jesus and the Gospels. These did not need to be reasoned to or defended. In the fullness of time, God decided to intervene by sending his Son into the stream of human affairs. That's a recognized fact, assumed at the beginning of the argument to be true and the basis for everything thereafter.

This became a fundamental shaping force in Western thought. Many of us still believe that this is a valid starting point. There are others who look upon this as superstition. Many fall somewhere in between. But, however you want to decide this precisely, this is a foundation stone in our intellectual edifice; this is part of our mental and spiritual patrimony.

Augustine accepted that the human race was created, pretty much as we are today, in Eden. Adam, however, started off with some special advantages which we do not enjoy today. This accords with a long tradition that the human race started out at a higher level of perfection than we enjoy today — and that something awful happened to befoul God's creation. And that something, of course, was Original Sin.

It was a fundamental belief of Christianity that God was personal — though unique — and in a close and special relationship with humans, whom he had created “in his image,” whatever exactly that might mean. Augustine developed this idea and worked it into his philosophy of history, which for him was no less than the story of this divine — human adventure. It was God's original plan that man would be in rational command of his bodily reactions: he would not be subject to passion: life would be a great deal easier, and a great deal more reasonable. Also, man would not have been subject to the sentence of death; after a period of time determined by God, man would be translated into the eternal kingdom.

Original Sin

Unfortunately, at the very beginning of human experience on earth, man sinned — the Original Sin — in refusing to accept obedience to the almighty father. The story of Eve and the apple was accepted not as allegory but as historical fact. As a result of this moral mistake at the beginning of time, evil befell mankind. Man felt shame for the first time; Adam and Eve noticed their nakedness and hurried to fashion for themselves garments. Death was introduced. Man would live a given number of days, after which his body would fall into eternal sleep. The world would continue its history, but things would never be the same. With these crucial elements taken for granted, the history of the Two Kingdoms would then unfold. The Earthly City was embodied in the Roman Empire; the Heavenly City first in the history of the Jews, the Chosen People, and, in the fullness of time, in the life of Jesus and the subsequent life of the Christian Church.

Augustine then builds his sweeping interpretation of history as he knew it. He contrasts the false gods of the Romans with the one true God of Christianity. He attributes the difficulties of the Romans and the ultimate disasters befalling the empire to their trust in the mythological gods of the Roman pantheon: Jupiter, Saturn, Venus, and the rest. He emphasizes that false gods, since they do not truly exist, are powerless to bring about good for the welfare of mankind or the state. But, he by no means discounts the power and strength of the Roman Empire. He was, after all, a Roman by birth, culture and education. He recognizes the destiny of Rome as the vehicle for law and governance in the world. But, by a logic driven more by faith than fact, he sees as the

true cause for this, not the power of the Roman gods or the virtue of the Roman leaders, but the power of the one true God and the elaboration of providence in Christianity.

He saw the struggles in the world around him as a conflict between the earthly and heavenly kingdoms, a conflict that was to be resolved only with the Second Coming of Jesus and the Last Judgment.

We may see this interpretation as squeezing the facts of history into a predetermined mold rather than as studying and analyzing historical fact as it presents itself, but the interpretation is powerful and far-reaching, given the fundamental presuppositions on which it was based. And, the important thing for us here is that this peculiar admixture of history and theology was the foundation on which the cultural edifice of our Middle Ages was constructed. These theories and convictions dominated European thought for a millennium and a half, from the time of Jesus until the Renaissance. They continue to influence contradictions in our world of today.

Building the Cathedral

In Augustine's day the Roman empire was approaching breakup. Its history had already spanned several hundred years. Its record had been impressive. It had come to shelter within its control and under its auspices the entire civilization bordering the Mediterranean Sea. It was frequently oppressive and excessively bureaucratic. Although it was to some extent representative, it certainly was not democratic. SPQR, the logo of the Romans, was recognized throughout the Western world: *Senatus PopulusQue Romanus,* the Roman Senate and People.

Traditionally, Rome as an empire ceased to be in 476 CE, with the overthrow of the last emperor Romulus Augustus by Odoacer, a mercenary military leader who was pronounced King of Italy by his troops. It is only an historical convenience, however, to date the end of the empire to that event. Rome for hundreds of years had extended the dominance of Roman law to the lands and peoples it had governed. When Rome fell, her rule of law did not suddenly disappear. Rulers came and went; centralized government generally gave way to local control, and affairs were sometimes chaotic, but the tradition and to an extent the practice of Roman law continued, with the publication in different centuries of various legal codices. The body of Roman law served as the common basis for European justice, passing eventually into the legal systems of European countries, so that in a very real sense Roman law continues to this day, accommodated to changing times.

The era between the last of the Roman emperors and the changes of the Renaissance is what we refer to as the Middle Ages. This was, in general, the time during which Cosmos I, as we refer to it here, developed and flourished. During the millennium from 500 to 1500 CE, there was in Western culture a broadly shared and accepted view of the world and the human condition, which enjoyed remarkable stability. If we are to understand the spiritual and intellectual adventures of the human race, it is absolutely critical to understand the important foundation stones of Medieval European culture.

For our purposes, we will think here in terms of two Cosmoi. Not really that there are two different universes. Rather, there have been two markedly different ways of understanding our universe, and both of them are intrinsic parts of our cultural history. Cosmos I is the universe of the Middle Ages; Cosmos II is the view of the universe that we have developed generally from the Renaissance on. Neither

is tight in terms of its boundaries, nor ever completely and exclusively defined. Both are generalizations made to achieve understanding, not clear demarcations we find in the world outside. There was a cluster of ideas and beliefs which had their heyday culminating in the High Middle Ages. They were the substance and spirit of an age. Since the Renaissance, we have developed ideas which in their sum are at variance with the earlier world view. Understanding these broad cultural elements is an important step to take in understanding the modem world.

As the institutions of the Roman empire fell into relative ruin, the infrastructure of the Roman bureaucracy fell into parallel decline. The great cities of the empire degenerated in organization and structure. Communications and trade languished. It took hundreds of years for the pace of civilization in Europe once again to quicken after the relative lethargy which settled on the land. From the fifth to the tenth century, approximately, the light of culture burned low, by comparison. The next several centuries, from 1000 to 1500 CE were a time of quickening cultural growth.

Charles the Great – Charlemagne – Karolus Magnus was crowned Holy Roman emperor in 800 CE at Aachen in Germany. Slowly, the national states of Europe came into existence. Profound and sweeping change was afoot throughout the length and breadth of Europe. The new culture was distinctly different from classical times.

Cities, Trade, Crusades

The changes that came in burgeoning European society were slow, but they were persistent and wide ranging. During the time of the Empire, there had been significant development in transalpine regions, meaning those regions on the other side of the Alps from Italy, which was looked

upon as a distant frontier, and barely within the pale of civilization.

The most highly developed province was in southern France, which to this day is known as Provence. Here there were flourishing cities, including the settlements now known as Arles, Orange, and Nimes. This area in those days was referred to as Gaul; the inhabitants as Gauls, and gallic of course is another word for French.

One of the best preserved of the old Roman monuments is the Porta Nigra at Trier in western Germany, originally part of the town fortifications. The Romans were by far the greatest military and urban engineers of the ancient world. In England, Hadrian's Wall is perhaps the most extensive example remnant of defensive ancient masonry remaining. At that, for purpose of reference, it is only fair to note that China's Great Wall, begun in the 7th Century, puts Hadrian's Wall to shame, both in concept and execution. That's a story for another day.

Rome faded, and with the breakdown of the imperial bureaucracy, government, law, and the exercise of power became very much more a local thing, out of which, gradually, arose the patterns of medieval feudalism. Cities grew up, either founded anew or built on the remnants of the Roman antecedents. The cities of Europe were partially under the sway of the developing nobility, but at the same time partially independent. The winning of town charters from the nobility established patterns of social and institutional growth which would have been unknown during the days of the Empire. Trade routes across Europe came to establish links between urban centers which spread news, goods and available technologies from place to place. Modern European cities have held on to their city centers where they could, sometimes rebuilding them along old plans after destruction by war or other calamity, as is true in

Frankfurt, where in our own time ancient buildings and trafficways were reconstructed after the leveling which occurred in WWII as a result of allied bombing. To this day, we can in Brussels and other important centers of city life see the central plazas, the town halls, and the guild halls which came to characterize medieval Europe.

In the twelfth and thirteenth centuries occurred the Crusades, that peculiar amalgam of greed and idealism, honor, and brutality, which gave to medieval Europe a unique quality for almost two full centuries (1100 to 1300, rounded). These military expeditions of western Europeans into the Middle East did as much as any other single movement to mold and channel the specific character of the Middle Ages. The Crusades were anything but homogeneous. They arose from different regions and kingdoms of Europe. They were at times bloody, cruel and self-interested. Although a western Kingdom of Jerusalem was established, which lasted during these two centuries, the direct effect of the Crusades was limited. Their cultural and intellectual effects in the end were of more importance and of more lasting effect than their political results.

Universities

In the days of Roman and Greek philosophers, there were "schools" of philosophy. Noted rhetoricians sometimes gathered their students and followers around them. But the process of education was not broadly institutionalized. The Roman orator Cicero gave an oration before the court for one of his teachers, Archias, a Greek, who in some fashion

had run afoul of the law. This speech survives to this day, and in Latin classes is read because of its balanced and humane support of liberal education.

In classical times there was a high regard for learning and culture. The upper classes made provision for its encouragement and continuation. In the early years of the Christian period, learning in general languished, although it did not disappear. We have looked at the learning and contributions of Saint Augustine and his early life as a teacher. The early Christian Fathers, as a group, created a considerable philosophical and theological literature, although the brunt of their effort was directed at reconciling the new teachings of Christianity with the philosophical concepts which they inherited from the Greeks, rather than at independent speculation.

The early rulers of Europe tended to be a rough and ready lot, more familiar with the battle ax than with the pen. Charlemagne, king of the Franks, was himself descended from a warrior ruling class. Adventuring he did aplenty, but he definitely was not of scholarly bent or achievement. The story is told of him that he kept a copy of the Bible close to him as he slept, not so that he could read himself to sleep by study of holy writ, for he was illiterate, but out of his respect for the written word, which he yearned to understand, but couldn't. Once when in Rome, Charlemagne had the good fortune to meet Alcuin, a cleric and a scholar from England, who happened to be in Rome on a diplomatic mission. Charlemagne prevailed on Alcuin to attach himself to the royal retinue. Working among the Franks for several years, Alcuin developed an educational program which was to be a lasting inspiration and model. This resulted in a revival of learning and the fostering of culture.

It is a mistake to think that intellectual life was the complete property of the Church. It is true that the Church

played a dominant role, and that theology was considered to be Queen of the Sciences. However, the other areas of erudition were never suppressed. Far from it. Rhetoric, logic and mathematics were expected to be a part of the armamentarium of the educated mind, although, for instance, there was scant appreciation of the potential power of cosmological mathematics. Descartes, Leibnitz and Newton had not been born and would have found themselves uncomfortably out of place.

But, as medieval society continued to differentiate and flourish, a need was recognized for education as an end in itself — a development the importance of which would be difficult to overestimate. The interest and support for more general education resulted in a peculiarly Western institution, the independent university.

The most obvious power in medieval society was wielded by the nobility on the one hand and the Church on the other. What we think of when we visualize the middle ages in our minds, preeminently, is either the Churchman or the armed Knight, and there are good reasons for this. But, like many stereotypes, the generalization belies either the complexity or the diverse reality of the times.

Throughout Europe the perceived need for education called into being the university as a fundamental organization. The University of Paris was one of the earliest, but during the same approximate time, which was also the approximate period of the Crusades against the Moslems, universities were founded in all major European countries: Oxford and Cambridge in England, Salamanca in Spain, Bologna in Italy, and Heidelberg in Germany (twelfth through fourteenth centuries).

Scholarship became not only an activity but a profession. The process of charging tuition of students to provide income for their professors and of awarding academic

degrees became important elements in the fabric of society, basic arrangements which have with modification persisted into current times.

Muslim Scholarship

While the Europeans were building their universities — and their citadels in the Holy Land – and the great cathedrals of Christendom – and their fortified cities like Carcassonne – the Moslems maintained strong traditions of learning and scholarship throughout the lands controlled by the caliphs. The work that was being done in the European schools was important. It gave to the European mind the structure they needed to maintain their society and make their culture flourish. But some of the greatest scholarly work of the Middle Ages was done not by the Europeans but by the Moslems.

Avicenna (Abu Ali al-Husayn ibn Abd Allah ibn Sina, 980-1037), was an Iranian philosopher and physician who came to be respected as one of the greatest thinkers of his times. He compiled a Canon of Medicine which for centuries was widely used throughout the mid-East and Europe as a standard textbook. His best-known philosophical work was the Kitab ash-Shifa (Book of Healing), which brought together a vast amount of material from many different sources, including Aristotle, observational science, and logic.

Perhaps of even greater importance was Averroes (Abu al-Walid Muhammad ibn Ahmad ibn Muhammad ibn Rushd, 1126-98), born in Cordoba, Spain, at that time a Moslem kingdom. His father was a judge there and instructed his son in the law, medicine, and philosophy. He led an active public life in addition to his scholarly work, serving as magistrate

and consultant to the caliphs. Averroes wrote several books on philosophy, law, medicine, and grammar. Averroes' extensive commentaries on Aristotle were translated into Latin as well as Hebrew, and through that channel had a powerful effect on Medieval Christian and Jewish philosophy.

In fact, it is an interesting side light on the history of thought that the medieval philosophers of Europe knew Aristotle only through Latin translations via the Arabic. They did not have the original Greek texts. When these became available, much later, at the time of the Renaissance, scholars were happily amazed to discover how faithful the double translations were to the Greek originals.

High Middle Ages

The culture of the high Middle Ages was highly diverse, energetic, and stretching at the boundaries of its own consciousness. We have a tendency to look back on the Ages of Faith as a time of superstition and blind acceptance of ecclesiastic doctrine. That would be a sad oversimplification. Medieval scholarship was extensive and profound. But, relatively speaking, the thinking of the medievalists tended to be thinking about thinking. That is, the work of scholars was concerned mostly with understanding and further developing the thought and writings of other scholars and authors, whether in their own tradition or as inherited from the classical writings of the Greeks, the Romans, and the Jews.

And, which is of critical importance to the development of thought and discovery, through the Middle Ages, and, in fact, until relatively recent times, the scholars of medieval Europe operated under the beguiling intellectual

blandishments of *Mundus Mendax:* they had no other option than to accept the human animal as he/she appeared to be, as a "given." They had no even foggy idea of the lengthy history through which man had developed for 3,000,000 years. Even less did they have any conscious knowledge of the complicated biological substrate which evolved over long eons, and was the supporting structure for the processes of consciousness by which they were doing whatever thought and reflection they were capable of. If they ever had the opportunity to view the human brain directly, as in the case of severe trauma, either in war or civil accident, they would have been totally baffled by the presentation.

Aquinas

Thomas Aquinas stands out as the medieval scholar *par excellence.* He was broadly read, incisively intelligent, and, most importantly, metaphysically insightful. He shared the medieval proclivity for accepting human nature as he found it. Still, many aspects of his psychological theories and moral teachings hold considerable cogency. He was a profound student of Aristotle (through the Arabs!). He was a prolific writer of philosophy and theology — his works make up a considerable collection on the shelf. He was seriously dedicated to the task of making cohesive and consistent sense out of Sacred Scripture as he found it, and of the human situation as it appeared to him to be.

His scientific understanding of the world was seriously limited — as how could it be otherwise? His most important contribution was in understanding and enunciating the place and importance of existence in our world and in our perception of it. But, there is a considerable epistemological problem of understanding this dimension of Thomistic

thought and integrating it with our more modem understanding of the observable world. The empirically trained mind has a considerable hurdle to overcome in order to understand Thomistic metaphysics. Typically, empiricists want metaphysics to look like more physics. Metaphysics is a discipline and a science in its own right, and the empirically trained mind wants to get to the factual heart of things, which can present its own obstacle. The problem is that metaphysics is a different — but necessary - slice through reality, and gives a cognitive dimension that observational and measurement-based science cannot do. But, that is what gives metaphysics its special character, and that is why it is necessary for a complete view of the universe.

Heritage of the Spirit

Understanding the thought and spirituality of the Middle Ages is important, for two reasons, one of which is simple enough, the other a good deal more complex. The first is that medieval thought, as a matter of history, is antecedent to our own. The second is that we have moved beyond medieval thought because of its limitations, but we do not know at all clearly what we need to repudiate, because it is incorrect; and what, on the other side, we should keep, because it happens to be right! The current science-religion movement arises from a nervous feeling that empirical science, though powerful, is incomplete.

Religious and religious philosophical thinking are still strong currents of conviction in our society. We are far from being willing to remove the idea of God from our struggle to understand ourselves and our universe. We do not have a good theoretical way to deal with the best of medieval

thought, whether to do away with it, or incorporate it into our modem theories.

Medieval thinking is sometimes seen simply as a deviation in human culture, an unfortunate departure from the rationalism founded by the Greeks. This shows slight sensitivity to the insights of medieval scholars. Medieval thought, while it proved to have its limitations, had qualities to it which are quite distinct, and deserve consideration in themselves.

Life under the empire could be very cheap. Look at the gladiatorial games and what they stood for. In 71 BCE, after the successful suppression of the rebellion of Spartacus, 6,000 of his followers were crucified along the Appian Way. The empire was a vast bureaucracy, and it gave very little place to the importance of the individual. The raw cruelty of might was moderated by the universality of Roman law, but there was little in Roman society to give meaning to life itself. It was a difficult world into which came the message of Christianity.

The picture of human life developed by the medievalists was complex; it was also markedly complete. There was very little, apparently, for which it did not account, in some significant fashion. From a psychological point of view, what Christianity brought with it was a powerful message of the value of human life. The emergent story of Christianity was, as we have seen, the adventure and ultimate success of the Kingdom of God. The human soul, in the Christian world view, was of immense value. The incarnate Son of God came to earth for the salvation of souls, and gave his life for that purpose.

Life for the Christian was not insignificant. It was, rather, cosmically important. Salvation was to be aspired to and shared in by each and every individual human being. Christianity gave to human life a focus, a process and a

meaning. This was its first and most outstanding contribution, and it made a huge difference. By the time of the Renaissance, man felt individually important. He knew who he was. He understood the world in which he found himself. He knew what ultimately his destiny was to be. To be a Christian was a far cry from what it was to be a Roman.

The first gift Christianity gave man (and woman) was a clear sense of spiritual significance. The second was less obvious, and more esoteric. Underlying the more external message of Christianity was a profound and penetrating metaphysics. The metaphysics of Christianity was a set of convictions, theories and experiences which ran deep into reality, and made a profound background for the more superficial doctrines of historical salvation. To simplify, there was a God in the universe, the source of the nature of things and of their existence; and this God had revealed himself in the Universe through Jesus.

Moral History: Man and God

Guilt is an unintended by-product of intelligence. And, the route by which that comes about is not exceedingly difficult to identify. Guilt arises when we see ourselves engaged in activities which are destructively maladaptive. Guilt in its origins should be a rein to keep us within the confines of humane behavior. But it's not an unmixed blessing, by any means. Frequently, many humans fail to experience guilt where they clearly should, and, as frequently, humans feel the emotion of guilt needlessly and to no avail.

The two largest contributors to Western thought and culture were, as we have seen, the Greeks and the Jews. The tribal ethos of these two peoples was a lot different. The Greeks were more imaginative, more playful and, at the same time, more cerebral. The Jews were more feeling driven, in a way more passionate, and more inclined to cling to deep commitment to tribal loyalties. But, if they were different from each other, both the Greeks and the Jews, compared to other peoples, were action oriented, ready for war if necessary, and willing to lay down their lives if need be, not as slaves driven by the lash, but as heroes driven by tribal loyalty and pride. It was better for a Greek to be carried home on his shield, dead, that to return without it, defeated.

It is interesting that both the Greeks and the Jews had mythologies which told of events near the creation of their kind, and that both of these mythologies had essentially the same tale to tell; to wit, that things started out pretty well for their peoples, but that that state of well-being was lost due to the vanity or foolishness of a woman. Neglect here, if you please, the sexism implied in that, and attend to the similarity.

In the Greek mythology, Hephaistus, the artificer of the gods, made Pandora, the most perfect of maidens, as a gift for Epimetheus. There was only one hitch. As the gods bestowed on Pandora their gifts of beauty, loveliness, and intelligence, they also gave her a box, concerning which she had one sole duty: never to open it. Her girlish curiosity got the better of her. One day she opened the lid of the fateful casket. Out flew all the evils and demons that beset the human race, there being left behind only Hope, to keep man company and to support him in his troubled trek through a dangerous and often discouraging life.

The Jewish allegory, the story of Eve, the first woman, is much more similar to the Greek tale than it is different, but it has some interesting twists. First, the opposition of God and the Serpent establishes a clearer duality than that of the more varied symbolism of the Pandora story. Second, the strict morality of the situation is underlined in the naive innocence of our first parents during their pre-experiential phase, only to be followed by shame and guilt and a need to cover their nakedness.

But, for our purposes, the critical observation is that Cosmos I was, more than anything else, a universe of moral adventure, a universe limned with broad strokes of Creation, Sin, Redemption, Salvation, and the coming eventually of a New Heaven and a New Earth. The fruition of the universe, in the Christian view, was anticipated to come about through a moral and spiritual economy. This is what seemed important to the spirit of the High Middle Ages, and it really didn't make a great deal of difference what was the exact nature of the stage upon which this drama was played out.

The Crusades could happen. National states could grow with their kings and queens, knaves and princes. Cathedrals and strongholds could be built. Slaughter, pillage, and rapine could spice up the day 's fare, but what was really important was the unfolding of the moral drama of man's sinfulness and the restoration of the universe in the mystical death of God's own incarnate son.

Cosmology

The moral story of creation and its aftermath was what seemed important to the medieval mind. There had to be some account of the locus for the adventure, although it was in a sense almost incidental. If you tum to the Summa

Theologica of Saint Thomas, you don't find a reasoned empirical description of the cosmos. But, that doesn't mean that there wasn't any account at all. All that means is that when the itch of empiricism demanded the scratch of discovery, the cosmology it encountered was a relatively primitive one, mostly inherited from the scriptural books or the half-developed speculations of the Greeks, and not resting on a solid observational base.

The earth was considered to be a young creation. The Biblical account of God's action was accepted literally. The earth had been created by God in seven days — whatever the duration of those days was. The universe was geocentric. Our world was at the center of things, with the sun, moon, and other heavenly bodies carried around on concentric crystal spheres. This system derived mostly from the theories of Ptolemy, a second century Greek astronomer. Heliocentrism, the theory that the Sun is at the center of things, had in fact been considered by the Greeks, but putting the Earth at the center seemed to do less violence to common sense, and that, therefore, was acceptable.

The closest sphere to earth was the Moon, followed by Mercury, Venus, and the Sun. Beyond that were Mars, Jupiter, Saturn, and the so-called fixed Stars. To explain the motion of the planets, Ptolemy postulated smaller circular orbits called epicycles. The centers of these epicycles, themselves in circular orbits around the earth, were referred to as deferents. The Ptolemaic system never really worked precisely, but it provided a plausible theory for the observed motions of things. The Arabs tinkered with the system trying to improve some of its inaccuracies — but the impossibility of making the system work was what would ultimately bring Ptolemy's theory crashing down around the ears of Renaissance thinkers.

There were different theories of elements, the most common being that there were four basic physical elements, or states: earth, air, fire, and water. This theory built on the observation that things seemed to be either moist or dry, and either solid, gaseous or liquid. These qualities seemed to be explainable on the basis of the four primary elements, so stated. A fifth element — to give unity to the system — was called the "fifth element," the quintessence, which was felt somehow to permeate all things, and to be the constituent element of the heavenly bodies.

What is hard for us to understand is how very recently this is the way that our ancestors thought about the cosmos, if they had any ideas at all. The first serious effort that anyone made to give a date to the age of the universe occurred only about 350 years ago — in 1650, or thereabouts. This was well after the Middle Ages had come and gone, and after the foundation of the first American colonies! An Irish prelate, James Usher, worked out a system that dated the creation of the universe at 4004 years before the time of Christ. Until his time, that hadn't even been considered a meaningful object of curiosity. What difference did it really make? Usher based his reflections on the amount of time required by the generations of humans recorded in the Bible, and he felt he could determine the result with considerable accuracy.

Renaissance

In the centuries immediately following the high Middle Ages, there occurred in Europe a cultural flowering referred to as the Renaissance. It was a time with new sets of internal contradictions but, somewhat paradoxically, new

fulfillments of elements which had been present in society for generations.

It was a time for virtuosi to express their creativity, for, on the one hand, there was wealth and a need for the accoutrements that wealth can bring, and, on the other, there was plenty of room for new thinking, new styles and new traditions in all the arts. There was a need for genius, and scores of brilliant men stepped forward to respond to the opportunity.

Dante Alighieri (1265-1321), a Florentine, was in the vanguard. His poetry linked the styles of ancient epic poets with themes which at the same time were specifically Christian, yet recall the forms and content of classical antiquity. In that, he set the tone for the age and the style of Renaissance creativity. The incomparable Leonardo da Vinci contributed to art and architecture, as well as to invention and the design of armory and fortifications . Bramante, Borromini, and Brunelleschi designed and directed the erection of private and public buildings which to this day stand as matchless examples of grandeur, sometimes restrained and other times extravagant. Desiderius Erasmus, a 15th century humanist and philosopher, was both a powerful supporter of Christian thinking and at the same time a shrewd and merciless critic of the misuse of both ecclesiastic and civil power.

The national states of Europe and the royal dynasties which ruled them were either founded or strengthened. The nobility generally strove to buttress their importance and culture through the patronage of all areas of creativity: thought, architecture, poetry, theology, furniture design, painting, and sculpture. The Church was important in creating and supporting the creativity of the age. Unhappily, it was occasionally a towering scandal, forsaking the simplicity and humility of the basic Christian message for

personal and institutional display, extravagance, and, sometimes, depravity of lifestyle.

Dante in his writings eschewed the Latin of the scholarly world, writing in vernacular Italian. Scholars of the age frequently bounced back and forth between the language of scholarship and the language of the marketplace. This led to the development and flourishing of national literatures throughout Europe: Spain, Italy, England, France, Germany, and the Low Countries.

In the middle of the 15th century, the invention of printing with movable type was as explosive a step forward into mass communication as, *mutatis mutandis,* the internet is in our own time. By the end of the century, hundreds of printing houses throughout Europe were turning out hundreds of thousands of books of all possible ilk: classics, technology, current literature, philosophy, and satire.

In the midst of this great explosion into individuality and creativity, religion itself, in the sense of a unified Christian Church, foundered. True, since the first centuries of the Christian era, there had never been total recognition of authority or total orthodoxy. In 1054, eastern Christianity had split off from Rome. In the west, a combination of loyalty and coercion had held the Church generally together. But, from the 16th century on, starting with Luther's 95 theses on the church door at Wittenburg, Christendom splintered and divided, never again to be gathered within one communion.

And yet civilization was still more homogenous than the opposite, and underlying beliefs and assumptions tended to be much more similar than different.

Cosmos I

And thus, Cosmos I. It has taken us quite a while to get here. Approximately 15,000,000,000 years, or thereabout (+/- a mere billion years or so). That's quite a long period of time. But, as we have come to realize, the world was not instantaneously created. It took a long time to develop from a colorful and explosive beginning. When man appeared on the planet, he/she didn't have much of a real idea about his/her origins. As we have seen, the world played a bit of a trick on him/her. Cosmos I was the developed idea of the universe as man first conceived it — from the beginning of time, through prehistory, through early civilization, through classical civilization, and through the 1,500 or so years from the lifetime of Jesus Christ to the High Middle Ages. Or — until the dawning of the cultural upheaval we have come to refer to as the Renaissance. This story has been told through the eyes of a Westerner, grantedly. It is a story that has prepared us for the onset of the scientific age in which we now all live. The societies of the earth have become confluent with each other, in spite of continuing dissonances. Other streams of thought and development have poured into the human drama. This story is not meant to discount those other streams. This is a highly selective account, but a true one. It helps to explain what we are doing on the planet.

Cosmos I was the world which man created in his mind. He was inclined to take himself as he found himself, and to understand the world as it appeared to him. Psychologically, it would have been impossible for man to head straight for the truth and stay on the path in an unerring way. Not just a matter of the odds, but of the intrinsic nature of the enterprise. Man started where he could, and his first major attempt at explaining his world, and making some sort of intelligent sense out of it, was one that had some right things about it, but some heavy-duty misconceptions as well.

History would prove that Cosmos I required major shifting of intellectual gears. And, in fact, that process of readjustment is one that we are still in the midst of. Cosmos I was dynamic, diverse, and immensely creative. It gave direction and purpose to individual and social life. It also came increasingly to creak at the hinges. You can build cathedrals only so high. And then the vaults fall in.

Through their energy and ingenuity, and building on their historical inheritance, humans had succeeded in constructing a rich and varied culture. Although the biological roots of humanity went back to the first stirrings of life in primordial seas, the human cultural explosion was of much briefer duration — 5000 years, more or less, depending on where to draw the line. Romans and Greeks, Scythians and Goths, Moors and Moslems, Crusaders and Norsemen, Christians and Druids, Germans, French and Englishmen, saints and sinners had all been thrown into the pot and stewed over the hearth of history.

The Vision of Faith

The seeds of discovery had been sown, geographically, technologically, and scientifically. They lay germinating in the soil of civilization, watered by the affluence of nature, and by human sweat and blood. In spite of this extreme diversity — the diversity which has since produced the world we know — there was a remarkably consistent and widely held common view of the cosmos. Lopping off the incidental variations, Western man (and woman) viewed the world through similar spectacles.

Homer, Aristotle, Pythagoras, Cicero, Jesus, Augustine, Charlemagne, Aquinas, Leonardo, Michelangelo, and Shakespeare had all made their contributions, as, indeed,

had countless others. The world of 1500 was an amalgam of everything we have observed in our considerations to this point. Earth was the transactional as well as the physical center of the universe, and the stage for the human drama — the Divine Comedy. Earth had been created by the direct action of God pretty much as it appeared to be at the time, and not that long ago. Even educated minds didn't think that much about the actual chronological duration of the home planet. That didn't matter that much. What was important was the spiritual adventure of the race, worked out largely within the political framework of European nationalism.

Man had been created by God, quite as pictured on the ceiling of the Sistine at the Vatican. Woman, as per Michelangelo under God's fatherly arm, was waiting to be formed from Adam's rib. Humankind had been cursed through Adam and Eve's Original Sin of disobedience, and needed to work out salvation in toil and pain. God had sent his Son into the world in the person of Jesus, who was sacrificed on the altar of the cross, executed by the power of Rome in an obscure province of the Empire. Human evil would try to extinguish the light of the Incarnation, but the light would prevail through acceptance and obedience by the Christ, rectifying the disobedience of Adam's sin.

The Christian Church would continue the redemptive work of Jesus, guiding and enlightening the children of God through its magisterium and its service as the repository of divine truth. In the fullness of time, Jesus would return seated on his throne in the clouds to set all records straight, and to establish the open fulfillment of his kingdom in a shining, new and undying universe.

This was Cosmos I as it appeared to prince and pauper, churchman and lawyer, farmer and candlestick maker alike. The pressures within this matrix were strong for change, and change there has been. But the vision came from great

depths and had settled deeply into the European unconscious. Since, there has been cross dissemination with all the cultures of the world. The vision of Cosmos I has been in internal turmoil, but it still remains strongly operative as our spiritual heritage. Its influence continues to run deep.

The Rat at the Root

The Christian spiritual edifice was every bit as spacious and intricately developed in theory and content as were the great Cathedrals of Europe in stone. It was remarkably complete, in its own way, and amazingly comprehensive in the breadth of its coverage. It gave status and location to the life adventure of man. It explained man's origin, the struggle of his life, and his ultimate destiny. It explained much, on a philosophical level, to be sure, about the relationship of human body and spirit. It gave a framework and a system for responding to every possible question that might occur to human beings — well, almost every possible question. If it really had all the answers for everything, we would have stuck with it in ways that we did not. As it turned out, the confines of medieval thinking chafed more and more, like a snug wet shoe that was drying out.

We became more and more uncomfortable with the scrapes and pinches caused by the medieval mindset, until gradually we set parts of it aside, and learned to use our minds in different and novel ways. There was a grave and serious problem with the edifice of medieval thought. It seemed to have answers for just about everything, but — and here was the rub — its explanation of the empirical manifestations of the visible world proved to be inadequate. As it succeeded in giving scholars and thinkers, as well as

the man on the street or behind the plough, a psychological place in the sun, its explanations for the phenomena of observation stretched thinner and thinner, until finally it was no longer sturdy enough to contain the outward pressure of thought, discovery and curiosity.

The intrinsic weakness in the mind and soul of Christendom was that in its pursuit of comprehending salvation, it undervalued the weakness of its observational underpinnings. This was not just a matter of accumulated facts. It was also a matter of process. The framework of medieval thought relied highly on authority; first, on the authority of previous thinkers and authors, and secondly, on the authority of the hierarchy of the Christian church. Many things claimed a right to intellectual acceptance because somebody said they were true, and, as a matter of process that became less and less acceptable, as more and more intelligent and creative people became more and more accustomed to achieving success in matters of study and learning as well as in matters of manufacture and commerce. This was gradual, but whispers grew into loud choruses, and creaks in structural timbers became the sounds of whole buildings falling apart.

Breakup of Belief

There was never a day when everyone woke up and realized that the Middle Ages were over. There was never a day when the travelers on the ship of destiny realized that they had just jettisoned the beliefs of Cosmos I. There wasn't such a time at the Renaissance, and there isn't such a time today. Rather, thinkers — seekers — knew full well that they had discovered things that convinced them they needed to move on. But they did not systemically abandon everything

that they had prized. What did happen is that minds which had ventured into the process of discovery contacted truths which they found compelling and convincing — so they had to follow them.

Some of the convictions of Cosmos I were true. Others manifestly were not. But it has not been easy for humans to move deftly and assuredly from the beliefs and perspectives of Cosmos I into clear daylight. Individuals and groups have held on relentlessly and irrationally to the content and perspectives of Cosmos I. Others have become so negatively sensitized to Cosmos I that they pitch out valuable things just because they are carried in a Cosmos I vehicle, rather like throwing away a precious diamond because it happens to be in an antiquated and outdated setting. Some of the thinkers who built Cosmos I got some things right in an enduring sense, and it is a loss to throw those things out because they may have been enunciated by a monk strolling along the Seine in a religious habit.

But, the pattern of religious and authoritarian belief which characterized medieval thinking tottered more and more as the horizons of the empirical world broadened. If man was to continue to move ahead, the structure of faith simply had to be questioned. We needed to understand the broader universe as it truly(!) is, and to get there we had to abrogate the authoritarian belief matrix of the Middle Ages. We still live with dynamics of that breach. Empiricism has its limitations, and part of the trick of thinking correctly today is that we need to be able to respect and utilize observational method for what it does, without making the mistake of falling into the belief that observational positivism is the only way of knowing the universe, or that positivism can tell us all we need to know. Using empiricism to learn about the universe is an impressive tool for grasping

what we need to know. Undoing its distortions and reestablishing balance proves to be equally important.

Chapter the Third

Cosmos II

Star Gazers

Since time immemorial, we have gazed at the stars and have been moved by wonder. We have tried to read more into the heavens than they are capable of disclosing, using the heavenly bodies as harbingers of the future or guideposts along life's journey. My daily newspaper continues to carry a constantly updated astrological section. In olden days, shepherds on the hills beheld the stars and created myths to identify and humanize constellations. They thought that the stars were arranged in patterns, and that those patterns could be made meaningful for people. Stars are brighter or fainter, but to the naked eye, they all appear to be at about the same uncertain distance. It came only as a much later realization that stars are at immense distances from us, and in fact are as far separated from each other as we are from them. The appearance of them being “fixed” is only an artifact of our viewing them from so very, very far off.

Back in the recesses of prehistory, our ancestors came to the realization that there were wanderers among the stars. We named them planets. Stars and planets, and the Sun and the Moon, put on a marvelous show for us, and, indeed, defined so very much of the periodicity of our lives.

Warmth, vitality, light and darkness, weather, the circle of the seasons, growth of crops and the fur coats of animals, many things seemed to be predestined, planned and controlled by the heavenly bodies. Not unusual, then, that we should try to harness and understand that wisdom, and make it serve our needs and hopes. There were astrologers who studied the planets and stars, and strove to intertwine the destinies of individuals and kingdoms with the order and wisdom of the skies.

Tying together the dynamisms of cultural streams, it is both curious and charming how when the infant King was born in Bethlehem, there came three wise men to pay him homage. The wisdom of the East and of astrology bended knee before the Babe in acknowledgement of a deeper wisdom than had previously shone in their hearts. And then, as mysteriously, they disappeared into the East at the behest of God's messenger, to escape the murderous intentions of a paranoid ruler!

As merchants and admirals increasingly felt the need to sail at the right time and arrive at the right place, they learned more and more to place their location by the direction and position of the stars. The astrolabe, “star grabber,” had been initially invented by a Greek, Hipparchus — and probably others, as well. By orienting a zero spot on the circle of this instrument to the horizon, the elevation of a star could be determined by pointing towards it with an index. This became a critical instrument of the Middle Ages and early age of discovery for Muslim and Christian alike. Tyco Brahe, the iconoclastic Danish astronomer of the 16th century, gathered amazingly accurate data using a giant astrolabe. His measurements served as the basis for the work of several generations of star gazers. Precise observational astronomy moved into a new range of credibility and importance. This growing body of study did more than any

other single movement to jiggle the stability of Cosmos I and, gradually, to stand the known world on its intellectual ear. The Renaissance astronomers were themselves devoted and committed Christians. Their intent certainly was not to revolutionize thinking or disturb God's plan on earth. They were doing what experience demanded of them, but their bold discoveries ended up rocking the bark of Peter much more grievously than anyone could have imagined.

Three men in particular stand out: Kopernik (Copernicus), Kepler, and Galileo.

Mikolaj Kopernik (1473-1543) published his book *On the Revolutions of the Celestial Spheres* at the end of his life. He was a widely educated cleric, elected in 1497 as a canon of the Cathedral at Frauenburg. He had studied, masterfully, the major learning of his day: mathematics, astronomy, medicine, and theology. A loyal son of the Church, Copernicus had no interest in starting a revolution in thought. His reason for delaying the publication of his book until he was approaching death was a desire not to stir up controversy. The basic premise of Copernicus' work was that astronomy needed to describe the physical systems of the real world rather than philosophical models. But, his major proposals proved to be quite upsetting. In opposition to the approved thought of the day, he set forth the theory that the earth turned daily on its axis, and that it traveled in a yearly orbit around a stationary Sun. Not the way that astronomy had been taught for untold years!

Johannes Kepler (1571-1630) was educated in Tubingen, worked for several years in Graz, Austria, served as an assistant to Tycho Brahe, and then became the imperial mathematician and court astronomer to Rudolf II, the Holy Roman Emperor. Subsequently he served as mathematician to the states of Upper Austria. Kepler pushed ahead the work of Copernicus, developing the laws of planetary motion

which bear his name. His theories thoroughly laid to rest the earlier, geocentric model of the universe. The most disturbing of Kepler's theories posited that the planets travel around the Sun in elliptical orbits. The idea of circular perfection in the physical heavens was dealt a blow from which it could not recover. Further, he showed that a simple mathematical formula related the orbital period of the planets to their distance from the Sun. As a result of Kepler's work, mathematics, rather than philosophy or theology, became forever established as the primary language of astronomy. This was every bit as important as any of Kepler's specific discoveries.

Galileo Galilei (1564-1642), a contemporary of Kepler, was an astronomer of towering intellect. He is important for several different reasons. He wrote a treatise on the center of gravity in solids, as a result of which he was appointed to the post of lecturer in mathematics at the University of Pisa. He disproved the Aristotelian theory that bodies of different weights fall at different speeds. On a visit to Rome in 1611 , he stepped into a larger morass of trouble than he either anticipated or needed. He gave public lectures on the cogency of the Copernican systems of thought. This brought him into confrontation with Aristotelian philosophers and led to a formal Church condemnation of Copernican theory in 1616. In 1632 he wrote his *Dialogue Concerning the Two Chief World Systems,* which enraged the Jesuits and led to his being found guilty by the Inquisition. He spent the remainder of his life under house arrest.

Even more far-reaching, Galileo was the first to use a telescope to study the skies, making several different discoveries. The greatest importance of this was the establishment of using instrumentation to extend our senses beyond their natural power and scale. This has been of central import to the progress of science in all its diverse

areas. We live, scalewise, in a middle kingdom, with things above and below us, megaworlds and microworlds, and instruments provide for us the windows into those worlds. Galileo was the first to use scientific instruments systematically to probe beyond our senses, and that may well be his largest and most significant contribution. Through electron microscopes and cloud chambers on one end of the observational scale, and the Hubble telescope on the other, we have scaled ourselves to realistic size; it was Galileo who opened for us those windows.

Francis Bacon (1561-1626)

England was not without its representatives during the exciting years of the Renaissance. A contemporary of William Shakespeare, Francis Bacon was a colorful figure in English history and in cultural history in general, but, additionally, he made a significant contribution to the shaping of scientific thought. He was primarily a man of action in public life, but his interests were far reaching, and his writings on the method of knowledge and science won him a unique place in the history of British empiricism. His middle life was a story of achievement and advancement. At 52, he was the attorney general of England, being appointed lord chancellor five years later. Unfortunately, he ran afoul of the system himself, and was convicted of accepting bribes in his own court. He paid dearly, losing his reputation and public offices. He ultimately died dishonored and in debt. That did not affect his contribution. He wrote copiously: philosophy, pure literature, and professional treatises. His contribution to thought and discovery was his insistence on experience as the only worthwhile source of knowledge. His thoughts on scientific induction contributed to the

development of scientific method. A major work was his *Novum Organum,* in which he inveighed against prejudices and preconceptions, calling them "idols." Picturesquely, he spoke of "idols of the tribe" (common modes of thought), "idols of the cave" (individual prejudice), "idols of the marketplace" (linguistic prejudices), and "idols of the theater" (over-reliance on tradition). His work had great effect on the French encyclopedists and the later British empiricists.

Bacon was a contemporary of Galileo, though the environment of his life was quite different. His contribution was more to the style of thought than to the content of discovery. With such men, Cosmos I continued to disappear further and further into the wake of changing thought.

Beyond Cosmos I

The architects of Cosmos I were convinced that they were right; that they had the essence of things knowable in hand, and that it was important to preserve and promulgate that truth. The vision of Cosmos I was psychologically powerful, and it was also extensive, inclusive and, at least in the active minds of its proponents, exhaustive. It explained much, and gave meaning, context and direction for human living. Anything with that set of credentials could expect a fairly assertive and faithful measure of support.

What was on the other side of Cosmos I seemed threatening to its primary supporters. Whatever it was that lay over the horizon not only was novel, and somewhat scary for that reason, but, more tellingly, there was an itchy anticipation that it might tum out to be politically inimical to the status quo, and that was even more unsettling. And, to the extent that those fears about upsetting applecarts

disturbed the minds of those who had become comfortable with the views and convictions of Cosmos I, truth is that they were correct. Their premonitions proved to be more true even than their fears forecast. It has, in fact, been painful and uncertain to move away from the most basic tenets of our earlier world view. The investment in earlier beliefs was deep and firmly set.

I suppose if a butterfly chrysalis had the capacity to worry about its metamorphosis, which it doesn't, it would be frightened spitless, which also doesn't make sense, at the prospect of going through the next inevitable stage of its development. That's an impossible set of suppositions, but there is a point which it elucidates.

Christendom's view of the universe was a critical step forward in man's effort to cope with his existence, and, in all truth, it is still not at all clear how much of that view we need to reinterpret in the light of later realizations, but, however that will ultimately come down, the following summary statements are true. First, we have had to move beyond Christendom's philosophies, but, second, that has been a metamorphosis which has not been at all easy for our civilization to endure. And, this should not be made light of. The questions raised systematically by history are frequently unsettling to face.

A New Mindset

Moving into the modem mindset was not quick. It was not simple. And, although modem empiricism (not philosophical empiricism, which is quite another matter), has been uproariously successful in certain areas, it has its limitations. Modem empiricism is the frame of mind which prescinds as much as possible from philosophical principles,

looks at the physical universe in specialized ways, and learns from the process of generalizing how things work. The modem mindset says, “Universe! As much as possible, I will try not to have any presuppositions about your nature or structure. I am going to take a part of your phenomenology — let's say, for instance, round balls of a certain weight, or different weights — and establish a frame of observation and measurement. I will roll balls down inclined planes, measure carefully times and distances the balls travel, and try to find mathematics which describe predictably the way this specialized little bit of the world operates.”

It cannot be said that the mathematical approach was altogether new. Pythagoras, a fifth century BCE Greek, took many precise measurements, and tinkered with physical objects. He formulated the theory which bears his name (the sum of the squares of the opposing sides of a right triangle equals the square of the hypotenuse). He also measured musical strings under tension and tried to work out general equations describing the way they worked. Archimedes, another curious Greek, figured out that a body immersed in a liquid or floating on it had its apparent weight lessened by the weight of the liquid displaced. That is a pretty abstract concept, and not the sort of thing that one easily intuits.

However, insights like those of Pythagoras and Archimedes tended to be isolated observations, and were not at the time elaborated into larger theories of general physics. The engineer-architects of the high Middle Ages mastered applied mechanics, as testified to by the marvelous achievements of the gothic cathedrals and the amazing fortifications thrown up throughout Europe. But here's the difference. Before the Renaissance (figure 1500 CE), there was no widespread appreciation that empirical observation in fact was a special sort of process with identifiable

presuppositions, special sorts of steps, and a unique sort of resulting knowledge. Mathematics was a discipline in the medieval university system, ranking with logic and rhetoric, but the idea wasn't really present that theoretical mathematics could in its own right serve as an instrument for broad understanding of the world. On a good day, medieval theology or metaphysics could create a strong sense of the moral qualities of human life, and, at times, of the significance of spiritual history, as it was conceived. But other than to use such thought as an exhortation for the good life, or the basis for ecclesiastical or social structure, there wasn't that much to *do* with it.

All that changed as we learned to marshal our observations and learn about how things are, not in the cosmic drama of salvation, but in themselves, physically.

A New Earth

The discovery of what the earth is “really like” has been a shared venture, contributed to by armies of individuals and by countless collective enterprises. It is remarkable how far we have come in such a short time. There have been 300 centuries since Cromagnon (us) started down the path of cascading cultural evolution (30,000 years). Figuring 6 generations to a century, this equals 1800 generations (6 x 300). That is an amazingly brief time, considering where we started from, and where we are today. The rate of “progress” has been phenomenal — and it is a process that continues. In the Christian tradition of Cosmos I, thinkers and mystics alike looked forward to a New Heaven and a New Earth. In a different sense, a New Earth has indeed arrived. Not what the medievalists imagined, and not necessarily a very nice place. The outcome of what we are doing is still to be

determined. It hasn't happened yet, and we do not know how it is going to happen. How it turns out is a matter, partially, of our free choices, and that, overridingly, is why it is important to get a working grasp on what is going on.

The earth in one sense is New, because our view of it is new. Just as was true of yore, the world view that has been emerging is not the same for everybody, and is never truly focused in one place, with one formulation. But nonetheless, a new view of the world has been evolving, in which we can share, which can enrich us, and to which we can contribute. The earth is New, because part of it is a new spirit. Things are being thought which had not been thought before, and new discoveries are being made. Man's increasing understanding of his universe is itself a new phenomenon on the planet. The expression of mind has changed. Novelty has made a difference. Finally, the earth is New because not only is the knowledge a novelty. The novelty is such that it will actually change the world, and has in fact already done so. We have changed the nature and experience of human life. We affect the environment. We are expending non-renewable resources. What we think makes a difference. What we do makes a difference. How we believe makes a difference. The pursuit of understanding is not merely an abstract exercise. What we are about in these pages matters.

Microcosm, Macrocosm

Our view of the scale of life is a perspective never shared or achieved by the ancients or the medievalists. We exist, as we have already seen, in a middle world, with things both

below and above us. Our perspectives are deeply affected by the adaptedness of our perceptions to this middle world in which we evolved, and which is the primary locus for which we are suited. This universe which is our size has spawned us, and it is this world which we are prepared to see. But, once again, the world is a fooler. We are led to believe that this world we see is the real world, and we discover that the world we see is radically different from how we see it. That interplay, back and forth, is an intrinsic part of the human experience, and must affect not only our empiricism but our spirituality. The denizens of Cosmos I developed instances of highly sensitive spirituality, and, since they were here first, it is indeed only fair to acknowledge their experiences as the primary analog of spirituality. But it is clear, in saying that, not only that spirituality is important and necessary, but that the spirituality of Cosmos I just won't do for where we are today.

Downwards, we have journeyed into the fine structure of things. Biological units are cellular, and organized, with neural communication systems. Molecular communication opens further the mystery of symbolization and information management. Atoms are closely involved with the interface between matter and energy, and below that, are yet further structured, but become more and more mathematical, and, oddly, grainy.

Upwards, we have gone beyond the solar system into understanding our Milky Way, and into galactic space. We probe towards the borders of a possibly borderless universe, and, upwards, too, reality turns more and more into mathematics. We got into this entire project by deciding that we couldn't make much progress from the starting point of finding design and purpose in the universe, and, still, as we reassess our position, we find that there is a very high level of design and pervasive information in our universe, and,

frankly, we don't really know what to do with that. Except, to continue to expand our knowledge of our universe, and to keep our minds and spirits open to the explosive and pervasive effects of our own expanding consciousness. The scary side to our journey of discovery is that we will apparently have increasing power to dehumanize and contaminate our universe — and how we will exercise that responsibility cannot be foreseen from our current vantage point.

Newton (1643-1727)

Isaac Newton lived and worked in England, having been born close to the deaths of Galileo, Bacon, and Shakespeare. His life and achievements can be used to demarcate the passing from Renaissance into the age of modern science. After Newton, science has been more clearly a profession, and we assume that anyone who identifies himself as a scientist meets some sort of rough criteria. Newton, indirectly, helped establish this cultural shift.

His life was bumpy, as has been true of many great thinkers. He was reared early by his grandmother, and, after grammar school, entered Cambridge at 18 (1661). He received his master's degree in 1668. His fairly long life — he was 84 when he died — was mostly devoted to study, experiment and writing, though he did assume some public duties. He was quarrelsome at times, but, most importantly, he achieved prodigiously in mathematics and experimental investigation, and wrote successfully about his discoveries.

Newton's chief successes were 1) the development of calculus, 2) discoveries in light and optics, 3) his justly famous 3 laws, and 4) a theory of universal gravity. Briefly, Newton's laws state: 1) the velocity of an object remains

constant unless acted on by an external force, 2) change in motion is proportional to force exerted, and 3) for every action there is an equal and opposite reaction. The Newtonian law of gravity states that attraction between bodies varies directly with the mass of the bodies, and inversely with the square of the distance between them. That super-brief summary does not do justice to the power of these principles. They changed the way we view physics and astronomy, and have not only served as powerful tools for understanding the external world, but have also stood as paradigms of what scientific understanding of the world is like.

The Scientific Age

After Isaac Newton, the accumulation of fact and theory snowballs unbelievably. Instead of standing out as the private work of individual men, science becomes a profession and an industry. In the 19th, and even more in the 20th century, university science departments expand, the scientific base of industry grows, few areas of empirical discovery remain unexplored, technology affects daily living more and more, and the empirical knowledge base of the race 78 GOD AND ATOM multiplies with dizzying rapidity. Scientific societies proliferate. Periodicals and books spread knowledge with instantaneous speed. And at the end of that period the computer and the internet impel the accumulation and dissemination of knowledge even faster. It has been possible here to give some idea of the early development of modern science by telling even if very briefly the life stories of outstanding participants in the project. And at that, there was much that occurred that we didn't have the opportunity even to hint at, much less

mention in detail. Exploration of the world happened. Industry expanded and became one of the major determinants of society. Technology changed every area of life and commerce. Communications were developed. Each of these areas has its own history.

Our interest has been in our changing perspective and our changing relationship to our universe. To achieve that end, we have used the lives and achievements of a handful of great men to characterize how changes came in the way the human mind dealt with its own experience and the environment in which it found itself. We have not come close to writing the entire story. We have only suggested scenes by sketching in a few lines.

Note: “Great” men doesn't mean wonderful fellows, or individuals free of the clamor and dross of ordinary existence. Many of the great men who have woven the fabric of culture have been petty or beset with all sorts of worries and problems. Which should stand as encouragement for all of us. The history of progress has been moved ahead by people who for one reason or another found themselves at nodes in the matrix where they saw something important, and were impelled for one reason or another — sometimes rather selfishly — to enunciate their vision. The tapestry is woven by men and women with a cosmic curiosity and an unavoidable drive to respond.

The detail of the story gets too hectic for us to continue the pattern of description by great lives. We will mention individuals where illustrative, but will also describe developments by area of invention and discovery. Work ultimately is done only by individuals, even though they may be supported by universities, societies, or enterprises. There is a group consciousness, but the group doesn't do the scutwork. In building a wall or a castle, someone has a general plan, but bricks have to be laid individually.

Our effort here is to make clear how and why our initial view of the world was formed (Cosmos I), and how and why it has changed (Cosmos II).

Shifting Gears

We started out with the realization that when our ancestors started developing preservable theories about themselves and the world they lived in, they were, psychologically speaking, already far advanced. They were already deep into the drama of evolving mind in the universe. They were covering territory they needed to cover, but territory we would later need to reevaluate. That is to say, over the long centuries when, first, the species was developing, and, second, our distant forebears were going through the long centuries of prehistoric adventuring, they did not carry with them an active memory of their own experience. This caused our ancestors to involve themselves in all manner of distortions. In a perverse way *(Mundus Mendax),* it was only through the process of doing it wrong that we could develop the tools to do it right. This is like the shaggy adage that making good choices comes only from experience, but experience comes only from making bad choices.

Taking things as we found them, we got entangled in the mystery of how things get to be what they are, and we answered that problem in a top-down way, when bottom-up was the fact of it. Socrates irritated his countrymen to death (his, finally) by using language to show that people didn't know as much as they thought they did. Plato thought that things around us are only material copies of ideal forms which had a reality of their own in a world somehow separate. Aristotle felt things caused through the specificity

of their substantial form. And thus emanated the problem of universals, which plagued Western philosophy for centuries. But, top-down thinking is better than no thinking at all, and to get to where you really want to start you may have to start where you can.

Earth

It is difficult for us to understand that the first circumnavigation of our world occurred less than 500 years ago, in 1521-2. Sailing under the flag of Spain, Ferdinand Magellan set out westerly across the Atlantic. He was killed on a Pacific island, but his ship continued on, and ultimately returned to Spain.

In the years since, there are very few comers of the earth that we have not explored. Mother earth is not without her continuing mysteries, but, wherever we tum, the horizons of ignorance have been pushed back. We have investigated a great many of the problems which have occurred to us.

Once our world was a mysterious place where we played out the moral drama of our creation, fall and salvation. Whether it still is, and in what sense, remains to be seen. The broad framing elements of Cosmos I are still there, in some sense. The human race did have a beginning in time, though humans seem to have developed in Africa, rather than in the mid-East, as the biblical account would seem to have it. According to our earlier belief, the earth came into existence in six days, and on the seventh day, God rested. It has been argued just what is meant by the “days” of creation, and some have wanted to plug modem theories into “days,” theorizing that the days of the Bible are not twenty-four-hour periods, but rather developmental phases of uncertain duration. We know now that the earth did have its phases,

indeed, beginning about 5,000,000,000 years ago. Its development was not phase by phase under the direct management of the Almighty, although the mystery of how the universe is as finely tuned as it is continues to pique our curiosity.

Instead, however, of the earth having been created as the backdrop for man's moral adventure, we have come to see our home planet as coming into existence in a non-descript area of spatial vastness, as the result of galactic dynamics. And, we ourselves — as all life on earth — as having developed by quite definable laws from the matter and energy which make up our cosmic environment.

We know there was a period when our Sun formed, and when matter not drawn into the Sun coalesced into planets at varying distances from the central fire. And that our earth is one of those planets, sharing in the larger laws of the cosmos. Earth is mostly iron, which exists in molten state not too far below the earth's surface. Lighter elements floated to the surface as early stages of cooling began. Silicon is the most common element of the earth's mantle, although to some extent all the stable elements of the periodic table can be found in the rocks which make up the land on which we walk.

The Composition of Matter

It was believed, in the prescientific culture of Cosmos I that out beyond the pale of earth, everything was composed of a unique substance, and that everything “out there” was perfect. Once we developed elemental spectroscopy, so that we could study the composition of the heavenly body’s great distances from us, we came to understand that the spaces between worlds and galaxies is immensely vast — but that

matter has the same composition and characteristics wherever it is found. In fact, the natural laws which control things on earth are nothing other than a local manifestation of physical principles which express themselves in the same way throughout the entire vast universe. Throughout the 300 years from 1700 to 2000, the basic physical qualities of large-scale matter, as we know it to be in ordinary experience, were extensively studied and exhaustively described. The characteristics of light, heat, weight, magnetism, and electricity became the commonplaces of high school physics classes.

But, the more we worked with things, the more we came to realize that the objects we see around us are themselves composed of sub-systems of smaller particles. In the 18th century, Lavoisier, a Frenchman, worked extensively with gases, acids, and metals. He is looked upon as the father of chemistry. Lavoisier observed that when elements join to form compounds they always do so in highly specific ratios, and when water is hydrolyzed, the ratio of hydrogen to oxygen is constant. Matter is somehow discrete below the level of our sensory experience. Such observations led to the realization that there are atoms and molecules which underlie our real-world observations. With that, atomic science was off and running.

In the early 20th century, Neils Bohr developed the planetary model of the atom, with a central nucleus surrounded by whirling electronic clouds. Erwin Schroedinger came along to develop theories of quantum mechanics. Albert Einstein developed relativity theory. The repercussions of this reverberate through most fields of complex measurement and theory: pure mathematics, physics, astronomy, and the interdependence and convertibility of matter and energy.

The investigation of matter on the small side has continued. Huge particle accelerators have been constructed in laboratories throughout the world, with the result that we more and more completely understand the internal structure and mechanics of the world beneath.

The Universe

During the centuries of Cosmos I, our ancestors thought that they lived at the center of the universe, and that everything beyond the earth traveled about them, carried on crystal spheres, which made a blissful music not perceptible by ordinary ears. The universe, to our forebears, centered on the human race, and the earth, man's home, held by far the most eminent place. It was only gradually that we felt this structure shudder and finally crumble.

Copernicus laid ax to the root of the geocentric universe, having become convinced that the Sun, not the Earth, was the center of the observable cosmos. When Galileo learned of the basic capacities of lenses working together, he discovered that ours was not the only moon, but that Saturn too had its satellites. We have seen how Galileo 's doctrines ran counter to the theories of the day, and how the Church came down heavily, forcing him to appear before the Inquisition to defend himself, and then sentencing him to house arrest for the remainder of his life.

It wasn't until into the twentieth century — not that long ago — that we began to realize that our cosmic neighborhood is only a very tiny part of the cosmos. We learned that we are but one of a billion stars in our home galaxy, which we have named the Milky Way. Looking out beyond our galaxy, we learned that there are at least as many — billions of them — galaxies as there our stars in our own

galaxy, and that the stretches of intergalactic space are unimaginably large. The universe beyond us is at least several billion light years across, meaning, among other things, that we here are infinitesimally small.

The earth, as we now know, is an incalculably tiny piece of real estate! And yet this is where the entire drama of life as we know it has evolved. Our brains are the most complex and most highly organized instance of matter we know of, but sizewise, this few pounds of integrally functioning neurons is so tiny as to be cosmically laughable. So, we should enjoy the laugh! We stand out not in size but in complexity and in the rare phenomenon of our consciousness.

The universe shows itself, too, to have had a beginning, around 10 to 15 billions of years ago, or about three times the age of our planet. There was a time when everything material was contained in an infinitely dense and infinitely energetic point. That state of affairs was intolerable, and the point exploded — although in an explosion unlike anything we know of on the scale of our existence. Fred Hoyle, the English astronomer, referred to the theory of the primal event rather dismissively as the “Big Bang,” but the scientific world said, in effect, “Yes! That's what we mean,” and the term has stuck and gained scientific as well as popular acceptance.

The evolution of the universe has occurred not randomly, but in a highly specific and exquisitely balanced fashion. There are several physical values which apparently need to be “just so” for the universe to happen. If things had been otherwise, we would not be here to talk about it. Basic cosmic values have been described in Martin Rees' delightful book *Just Six Numbers.* Einstein's theory of relativity gave new depths of understanding to the unfolding spectacle. The curvature of space seems to be such that the

cosmos is finitely large, but, paradoxically, it seems, without edges! It seems, because of the curvature of light and of space, that it would be impossible ever to arrive at the edges of things, were we to leave earth in a near infinitely speedy spaceship. But, particularly for the purposes of our speculations, there are several summary surprises which modern cosmology has added to our knowledge:

- The earth is not the center of the universe.
- Our Sun is one of billions of suns (stars) in the Milky Way.
- There are billions of galaxies at tremendous distances from each other.
- It all began with the Big Bang, and the universe continues to expand.
- The universe is not haphazard.
- Several constants need to be “just so” for the universe to exist as we know it.
- Sizewise, we humans are infinitesimally tiny.
- Our brains are the most complicated phenomena around.
- The laws of matter are the same on earth – and in us – as they are everywhere.

The Biosphere

Life began surprisingly early in the earth's history, at least 3 ½ billion years ago. Complicated life forms came much later; the vast explosion of life forms that we come to mind when we think of animals and plants occurred over the last half-billion years. The dinosaurs, which figure so strongly in our mental pictures of prehistoric life, roamed the planet for long millions of years, from 200 MYA to 65

MYA, when they vanished rather suddenly, probably, it is thought, as a result of a meteor strike upon the earth. The hominid line has existed for 5 million years+/-.

When we appeared 30-40 thousand years ago, we had scant understanding of the internal workings of living things. We considered, generally, that an omnipotent god had created life, endowing matter with life's marvelous characteristics. We accepted life as we found it, and developed what theories we could about its nature. It is only quite recently — within the last few hundred years — that we began to see living things in terms of their components.

The top-down view of living things encouraged concepts like soul and vital force. Bottom-up discloses a world of levels, each one of which has its own structure and function, but contributes to upper systems which develop unsuspected and surprising capacities. The first description of the cell was in 1665 by Robert Hooke, who had tangled horns with Newton, claiming that Newton had plagiarized from him his theory of gravitational attraction. Hooke described the gross morphology of the cell by looking at cork through a simple microscope. Soon after, the living cell was described in detail by the Dutch scientist Anton van Leeuwenhoek, and biology was off and running.

The cells of which living things are composed are in themselves highly complex biological factories, with their own internal organization and function. Cells are highly structured, each with its own nucleus (most commonly), its own array of organelles and mitochondria, and a highly complex machinery of sub-microscopic physical and chemical operations. When we began the process of modern discovery, we had no least idea of what we would run into on the cellular level, but this is where much of the biological research of today carries out its investigative business.

Once life process got a foothold in earth's receptive environment, its multitudinous forms proliferated in amazing variation and profusion. Though individuals within any species tend to be fragile and vulnerable, life in the aggregate is surprisingly hardy and persistent. There is hardly any environment on the surface of our planet in which life forms of one sort or another have not set up housekeeping. The biomass, the aggregate of all living forms, has transformed the planet, turning it into a complex laboratory exercise in practical biology. And, the more we understand about it, the more it is clear that life has been a self-generating and self-evolving process, bringing about complexity with no active external direction. The drama of life occurs by rules and mechanisms which are internal to the capacities of matter, and which in the very recent past we are coming to understand better and better.

For us, in particular, we have come to realize that, though we are vastly different from the atoms and molecules of the inorganic world, we are nonetheless derivative from those same atoms and molecules. The line of development is unbroken from the elements on the periodic table to Einsteinian relativity and our recent completion of our own genome map. This may seem threatening to some. But that is putting carts before horses. The reality is that great richness is given to the problem of the relationships between spirit and matter. Matter generates spirit. Rather than reducing everything to a materialistic basis, what really eventuates is that the universe participates in the universe of spirit more marvelously than we ever had dreamt. The universe indeed is “full of gods” as Thales opined, even though his view of that turns out to have been a drastic if unintended understatement.

We, too, are children of this process.

Cosmos II

Overall, we have developed a vastly different view of the world than mankind had when he contemplated what we have referred to as Cosmos I.

In the beginning of things, *Mundus Mendax* fooled us because as we have seen, 1) we lacked an active memory of our own evolution, and 2) we lacked an understanding of the physical nature of our universe, up to the stars and down to the quarks.

We turned our backs on Cosmos I because, whatever philosophical or religious truths it may have held, its general tenets and perspectives became more and more antithetical and oppositional to where the adventure of discovery was beckoning.

This movement of rejecting Cosmos I began in earnest around 1600 CE. It was not a concerted effort, a "club," or an association, although clubs and associations there have been in great profusion. What led to the development of the perspectives of Cosmos II was a complex of lures and motivations. It has not been a simple or uniquely driven phenomenon.

The overarching motivation has been thirst for discovery. Humans are a curious lot; they want to know what is going on, and, on broader planes, they want to know what the engines are that power the world and the phenomena they see about them. Starting at the beginning, how *are* we going to explain those tricky planets that scoot around the night sky? And, as it became clear through Kepler and later Newton that astronomical bodies obey numerical laws, how far can we go in reducing the phenomena of nature to mathematical formulations? And that, in tum, raises further cosmological questions. Matter seems indifferent to ideas

and inert, at least in some manner. How is it that we have these systems of numbers in our heads, and there seems to be a marvelous correspondence between the two systems: mathematics and external reality?

There are whole derivative universes of other reasons why we pursue the mysteries of nature. It's a way to make a living, either in our educational systems or in manufacturing and engineering. Many of the things we discover have very direct utilitarian applications. And, conversely, there are very few of the things we make these days that do not depend, on many different levels, on the scientific and engineering discoveries we have made. Science has revolutionized the way we interact with our world, and the way we extract a living from the earth.

Progress and change are all well and good. But (there always is a but), there has been a good deal of gear shifting that has gone on as we have passed from the mindset of Cosmos I to the mindset of Cosmos II. Not all of this has been comfortable and not all of this has been good.

We went to sleep in 1600 thinking the world was one way. We woke up in 2000 and realized that all around us, everything had changed. That is confusing.

Change

Change is a constant in human history. In homing in on the evolution of science and its effect on human knowledge and human belief systems, we have in these pages tried to emphasize the change in world view that has occurred over the last 400 to 500 years, since scientific method developed a solid and pervasive place in world culture. This happened without a clear demarcation. Change has always been happening, ever since (and before, really) our ancestors

walked out of the forest. Sometimes it sneaks in quietly, while other times it crashes like a thunderstorm. But, though change is a constant, it is not always easy to pick out and comprehend the elements of change. It does make a difference what things are changing into.

We as a culture had developed a world view which was pervaded by a spiritual and salvation-oriented view of the human race. Over the last 500 years, we have changed many of our basic perspectives about our world. We have been trying to tell the story of that adventure in a way that emphasizes underlying principles — the essential elements behind the incidentals.

As our understanding of the world has progressed, so has our capacity to interact with it. We march inevitably into the future. It matters how we view ourselves. Our values make a difference. The issues we are studying here are not just incidental aspects of armchair history. Although there has been great light shed upon our natural world by the discoveries of recent centuries, the changes we have been contemplating have also caused intellectual and moral confusion, and whatever we can do to bring about clarity is eminently worthwhile.

The unfolding future depends on our choices. Therefore the matrix out of which we make those choices matters, a great deal. Most choices that most people make, even those that substantively change the future, are not made on the basis of philosophical or even moral conviction. However, the context of our deeper beliefs and convictions about ourselves and the world we live in does, in the long run, make a difference in the way we couch and pursue our objectives, and the kinds of things to which we are willing to pledge our allegiance.

Advertising as a modem and worldwide phenomenon casts its messages in forms and language that would seem to

support a morality of limitless self-aggrandizement and uncontrolled dedication to unbridled hedonism, frequently with an openly sexual tinge. Those aspects of our consumer society suggest that mankind today is immensely pleasure oriented, and interested only in the narrowest sort of physical self-satisfaction and self-fulfillment.

Part of the reason why advertising seems to pursue these priorities is that they constitute a kind of social common denominator. These flashy accoutrements of daily living are easier to identify and pursue publicly than are ideas and values which carry no pricetags, and which lack clear rallying points for choice and action. Underlying ideas and ideals do not generally attract the direct attention of Madison Avenue, but, nonetheless, they have urgent influences on the end result of our actions and choices.

As we have made progress in understanding the universe and its mechanisms, we have made progress in our capacity to interact with the world around us and control the outcome of natural process. This has great cumulative effect on the environment, and on the character and quality of society. As we have penetrated more and more deeply into the mysteries and depths of the physical universe, we have changed, and continue to change more and more the very character of our interaction with our own existence.

Knowledge is Power

More and more, we have the capacity to destroy life and civilization on our planet. Concomitantly, we have greater and greater capacity to make available for humankind throughout the territories of the earth the advantages of physical health and spiritual growth. A short time ago, as the world turns, we thought the world was a self-contained

geocentric salvation machine occupying a central place in a tidy universe, under the close and proximate supervision of an anthropomorphic god. The universe turns out to be a great deal different from that.

Paradoxically, we know much more about how the universe works; but — we are much less certain about its purpose, or the shape of a developing future. The world is a more open-ended phenomenon than we expected it to be. We are uncertain what the world can develop into. We are uncertain what will happen as we move ahead, yet move ahead we will and must. And, it makes a difference what we believe and how we formulate our basic views of things.

There was a time when the Church, in the West, was the chief repository of ethical value and education in our culture. During the early and middle years of Christendom, the Church, more than any other societal system, preserved the best of antiquity and tamed, to an extent, the raging heart of emergent nationalism. Charlemagne extended his power throughout much of Europe in the 8th and early 9th Centuries. It was Alcuin, a churchman and educator, who provided leadership and skill for the furtherance of learning in the Caroline realm. Charlemagne slaughtered Germans and Franks by the thousands in converting them to the True Faith. This was a strange admixture of currents and crosscurrents, but it was the Church rather than the secular power that softened and inspired the better side of imperial strength.

Over the last century, the struggle has continued between strong men and civilization; it is unclear when, if ever, it will not be that way. But the pattern and distribution of power and value has changed. Less and less has church been the protector of human rights and the civilization of man's heart and spirit.

Comprehending the universe has ceased to be the prerogative of any particular organization or caste. Unconsciously, we have thrown the human enterprise into the marketplace of laws, ideas and social choices. Anybody in his right mind would view this phenomenon as scary, but it is inescapable. We don't seem very smart when left to our own devices.

The current Science-Religion movement has developed because we realize this. We know that actions and choices matter. We know that religion has sheltered human value in ways that nothing else in life has. Somehow we need to generalize what is worthwhile in religious experience into the matrix of society.

Over the last 200 years, there have been attempts to encapsulate human rights is declarations and charters we can live by. These are important, but they seem often to be "honored more in the breach than in the observance." From the French "Rights of Man," to the American "Bill of Rights," to the United Nations "Universal Declaration of Human Rights," to any number of their analogs, we know intuitively what we ought to be doing. We are not doing well in terms of translating principles into activity.

We are going to do something. We have the opportunity as well as the responsibility either of continuing to humanize earth's biomass, or to debase and destroy it. The world as we view it at the beginning of millennium III is different than the world of 1500. The fine detail, in any direction, is a matter of close study under specialized observational circumstances. But, the mind of the average interested person is quite capable of comprehending the essentials of our current knowledge about the material universe. We need a compelling restatement of the best and most enduring insights and values of Cosmos I, related to our knowledge

of the physical universe, as we have learned to express it in the insights and language of Cosmos II.

Chapter the Fourth

Evolution

A Developmental Universe

The universe has been a developmental place. That is a relatively novel idea. Not that long ago, the general conviction was that our world was created suddenly, and rather the way it appears to us now. The cosmic home that we inhabit is wonderful. It is varied, colorful, and a challenging environment in which to work out the adventure of life. With its many different climes and its great fruitfulness, it provides for us a home and a constant stimulus to our curiosity and creativity. It is vast enough that it has allowed several different cultures and civilizations to develop, yet cozy enough that an adventuresome spirit can cover a good deal of it in a lifetime. However, we do not get very far down life's path before we start running into obstacles. Our home can be pleasant and beckoning. It also can be hostile, threatening and lethal in its attacks upon us. Pestilence, thunderstorms, earthquakes, and warfare can all wreak havoc on the plans and lives of humans.

Though it is the source of all our knowledge, it is shrouded in mystery. And its apparent intelligibility is deceptive. Even the most apparently obvious things prove to be more complicated than they appear at first blush. The

processes of nature and life are complex, and we soon become impressed that nothing, absolutely nothing, is as it seems. Surface explanations and descriptions prove inadequate. Everything has relationships, and a history. Everything has hidden causes behind it and within it. Nothing is "simply there."

A modem automobile is a wonderful product of engineering, design, and economic development. A magic carpet to whisk us away to wherever we want to go. But, if we probe at all, we soon discover that this marvel of transportation has a history, which includes cascading sub-histories: the internal combustion engine, the discovery and development of fossil fuel energy, highway building, General Motors and Mercedes Benz, paint technology, Triple A, computerization, and what-not. Most of us are content with a smattering of knowledge about the makeup of a modern motor car — but the entire complex history is there if we wish to pursue it, and, really to understand cars, we need to know at least some of the supporting detail. The complex phenomenon of motoring is more than we can even begin to deduce just from looking at that conglomerate of plastic, rubber, and steel sitting out on our driveway.

And, such it is with the universe itself. We can make superficial sense out of it by direct observation and interaction, but if we hope really to understand it, we need to look at it from a developmental perspective. As far as our ongoing intellectual history is concerned, this is a relatively new realization, and we are at this point drawn back to the considerations of *Mundus Mendax* . The universe, though intelligible, is tricky. It cannot be taken simply for what it appears to be.

It has become increasingly evident that the world, from long ago, has been developing, and that an appreciation of that aspect of it is critically important. To understand

reality, we have to understand its evolution. Most modems would accept this principle without too much argument, although we continue to grapple with its implications. The problem, at this juncture, is that our development of evolutionary understanding, though significant, is still incomplete and to some extent controversial. It is not altogether clear what is important in the evolutionary picture, nor how the microprocesses of evolution have worked.

Inadequacy of Forms

Aristotle made a magnificent contribution to the intellectual life of Western culture. With the medieval theologians, he came to be known as "philsophus," *the* philosopher.

There was reason to accord him this level of dignity. His contributions to scholarship and learning were immense. He developed a strongly observational system of studying nature. He was an avid collector of fact. As opposed to approaching human nature in an anecdotal or moral fashion, he laid the foundation for an analytical and observational psychology. He shrewdly criticized literature and the theater, particularly with respect to their emotional significance and impact on the human spirit. Singlehandedly, he invented the science of formal logic. He summarized mathematics as it existed in his time. His analysis of human ethics has continued to this day to influence humanistic thought and our legal system. He saw the world as causally operational, rather than as animistic or mystical. He felt that through observation and analysis, we could get to an understanding of the world around us. He was, overall, deeply rooted in empirical observation,

extremely broad in his scope of interests, keenly insightful, capable of penetrating theoretical analysis, and remarkably balanced in his judgments. The Aristotelian body of writings represents even today a marvelous monument to human curiosity. He was, par excellence, *the* Philosopher.

There was, unfortunately, a downside to his influence. His approaches to the world around us became so deeply woven into the consciousness of the Western mind that his formulations and theories became almost second nature to the intellectual endeavor. His way of looking at causality and the metaphysical structure of being ended up being intellectual flypaper for later thinkers, and they had considerable difficulty pulling their understanding out of the goo. In his effort to explain how things exist, Aristotle identified four types of cause: material, formal, final and efficient. He explained the specificity of objects by positing a substrate of matter which is indeterminate in itself, but capable of being made what it is by formal cause. Thus matter constitutes everything around us, but is made to be what it is by form. Stones, water, wood, a chair, even man, are all material things. They have a common substrate. But they are made to be specifically what they are through formal cause. The formal principle creates the specificity we find in nature. That's a bold generalization, but as an overall explanation, it did not encourage delving into matter 's subsystems. It did not lead the mind to search for how things became the way we see them.

Aristotelian ideas became sacrosanct in their acceptance. Rather than using these generalized insights as a formulation through which to grow, thinkers took for granted that there wasn't a great deal more to be said about specificity, and that's all there was to it. *The* philosopher himself would likely have been thrilled at the idea that causality required a broader and more flexible analysis, and would have loved to

have new avenues of discovery opened up to him. Unfortunately, the assumption was made that Aristotelian causal analysis was the last word, and that that's the way the natural world needed to be understood. It took long centuries for thinkers to see things otherwise.

We got out of the Aristotelian framework by the back door rather than directly. When Renaissance curiosity pushed back the horizons of evidence and thought, we learned about the material world with accelerated success, independently of controlling theories about causality. We discovered the universe to be a much more dynamic and interesting place than ever occurred to Aristotle. Rather than dealing directly with Aristotle's classification of constituent causes, thinkers began measuring the world around them in ways that were independent of philosophical theory. Galileo accepted a Copernican picture of the universe not on the basis of prior convictions about causes, but because of what he saw through his primitive telescopes. Shifting gears mentally from an Aristotelian world to a world with a freer foundation in observable fact was not a simple process, but the beat of ongoing discovery became an insistent tattoo, not to be ignored. Empirical discovery caught hold.

After the Bang

The universe proves to be finite in time, and questionably so in space. We are uncertain whether there are “edges” to the physical universe, or the curvature of space mandates a universe which is both limited yet undefined. Cosmologists seem still to be struggling with the implications of observation and relativity. The issues are puzzling and complex.

Timewise, it's different. There are several different physical values which point to the age of the universe. But they generate a roughly similar conclusion. The universe is expanding; the stars and galaxies continue to get farther apart from each other. We can read astronomically what is going on now. If we reverse that process mathematically, we arrive finally at a time when all matter was packed together in an infinitely dense point of origin. Matter at that stage was completely unstable, a condition which could not maintain. Things "blew apart," rapidly expanding and differentiating into the building blocks of the material universe. That cosmic event has been referred to as the "Big Bang," and represents, as far as we know, the beginning of things in space and time. Estimates of how long ago that was settle on a value of 13 to 15 billion years (13-15,000,000,000 yrs). It is impossible for us to imagine that long a period of time in any way that has reference to our own experience; we can only imagine it mathematically. But, incidentally, that's true of many of the fundamental values of the universe.

We have not yet figured out all aspects of an amazingly differentiated cosmos, but the overall conclusion is inevitable: the universe which we know, and in which we exist and function, is developmental. Our cosmic home is sequential in its form and its history. Later stages in the universe have developed from earlier ones in ways that are both comprehensible and causally related.

Formation of the stars and galaxies occurred according to physical laws which we are coming to understand better and better. It appears that our own star, the Sun, is a second-generation star, coming after earlier stars had run their natural history and had gone supernova. First generation stars do not seem to be able to form elements higher on the periodic table. The makeup of matter throughout the

galaxies requires formation in the cosmic furnaces of stars now long gone from the cosmic panorama.

Our Earth, our home planet, formed roughly four to five billion years ago, from the circumstellar cloud left over after the formation of our Sun, and has had a continuous development since that time. The initial appearance of life occurred, surprisingly enough, closer to the beginning of the earth's history than toward the end. This is one of the reasons why we think there is a good possibility that life — and perhaps even intelligent life like ourselves — has developed elsewhere, where conditions have come into being similar to those on our own planet.

The Drama of Life

The world as we see it is a sheltering, though at times treacherous, place. It supports our lives and provides us with what we need for our existence. There is great variation around the globe in climate, terrain and life environment, and certain of earth's climes provide support for wild proliferation of living forms. Yet our cosmic home, our circumsolar nest, is far from being ubiquitously a warm and fuzzy place. The world can be harsh and intemperate; danger and threat are never very far beneath the surface of life's pageant. Life is in constant competition both with the elements and with other life forms.

Among our Sun's planets, Earth seems to hold a highly preferential position for the sustenance of life. The presence of liquid water, oxygen-rich atmosphere, distance from the Sun, even the planet's axis tilt, all appear to conspire to create a habitable home. We are drawn to wonder whether Earth 's environment is simply a highly fortunate quirk of nature, unique to our comer of this widely flung universe, or

is the symphony of life repeated throughout the universe in any number of star systems? Are we truly alone in this broad cosmos, or players in an evolutionary drama expressing itself with parallel history in countless other settings? At this point, we are quite uncertain. We engage in projects such as SETI — the Search for Extraterrestrial Intelligence — but, at least to date, we have had no direct evidence for phenomenal intelligence elsewhere in the cosmos. That problem remains unsolved, but there is little likelihood that we will abandon the search.

How likely is life to occur in a favored environment? Our problem on this score is that we cannot very well run independent laboratory experiments. We have one world, and our world has one history. That world, however, has proved to be remarkably fertile, and that apparently from the very beginning of the natural history of our planet. The hurdles to get life started seem very high, but what the fossil record strongly suggests is that life in fact developed quite early, in geological terms, once the planet cooled to the place that life was possible at all.

Our earth formed, from the perisolar cloud roughly four and a half billion years ago, over a period of a billion years. It took about that long again for conditions on earth to develop to a stage which would make life a possibility. But then, the first quiet stirrings of life showed themselves. The fertile earth did not lie dormant for any cosmically significant period of time. We have little insight into those first relatively simple chapters of life, nor evidence as to how those processes occurred. But, we know that life did happen. Those first complex processes through which inorganic chemicals arranged themselves into the much more complicated phenomena of biological systems did occur. That tells us something about the peculiar fecundity of matter.

We have divided geological time into four major periods, to aid in the understanding of our natural history: Proterozoic, “First Life”; Paleozoic, “Ancient Life”; Mesozoic, “Middle Life,”; and Cenozoic, “New Life.”

During the Proterozoic Period (4500 - 500 million years ago), fossils generally are rare. Earliest forms would have been unlikely to leave remains that would have survived. Towards the end of this period, however, there are plentiful invertebrate fossils.

The Paleozoic Period (500 - 250 mya) saw an amazing radiation of both plant and animal species. Life proliferated both in the oceans of the world and also on dry land. Mollusks and crustaceans appeared, as did land plants, arachnids, insects, and snails. Trilobites, ammonites and sharks entered the seas. Coal swamps developed, and many forms of reptiles roamed far and wide.

The Mesozoic Period (250 - 65 mya) introduced bony fishes and ichthyosaurs. On land, the dinosaurs appeared and established dominance. Archaeopteryx, the bird interform, plied the airways. The first mammals, small creatures at first, were pattering around in the great forests.

During the Cenozoic Period (65 mya to present), mammals took over as the most successful life forms. The dinosaurs were now a thing of the past. Modem birds proliferated. All modem life forms developed. Later — quite recently, in geological terms, the hominid line separated from the apes (5 million years ago). In the end, man appears — and, after that, everything we know as civilization and history. Reflective intelligence has been a quite recent phenomenon in this immense pageant. Culture, philosophy, religion, and science have, relative to the functions of the cosmos which generated us, been not much more than an eyeblink! Small wonder that we are still trying to get the story straight!

Cosmos I and the Radiation of Life

For the fifteen centuries – and more – of the Christian era, common people and scholars alike had accepted the biblical account of the diversity of life on earth. “When the Lord God had formed out of the ground all the beasts of the field and the birds of the air, he brought them to the man to see what he would call them; for that which the man called each of them would be its name. The man named all the cattle, all the birds of the air and all the beasts of the field; but he found no helper like himself.”

The focus of scholarship during these centuries was on the moral status of mankind, on man's relationship with God, and on the drama of sin and salvation exemplified in the life of Jesus and the Christian church which he founded. A focused theory of biological reality was not highly important, and was not given place in the system of study and investigation. In truth, the empirical machinery, psychological and otherwise, had not been developed that is necessary for the growth of detailed biological taxonomy and theory. It had been enough to say that God created the diversity of animals, and that man named them.

It had not occurred to thinkers that it was either significant or possible to give a specific accounting of the process of biological differentiation. To the extent that thought was given to the subject, it was felt that different species had been created directly by God — and that was enough to account for the diversity of plants and animals as we see them. During the 17th and 18th centuries — the centuries of Galileo, Bacon, Newton, and Lavoisier — but also, lest we lose perspective, of George Washington, Ben Franklin, and the War of Independence — the foundations

were laid for the vast assault on our understanding of the physical universe which developed during the 19th and even more the 20th century.

The tradition of spirituality established during the Ages of Faith continued. Although there were intellectual rebels and individuals labeled heretics, the vast majority of thinkers and seekers continued to be convinced of the truth and stability of the opinions which made up the core consciousness of Cosmos I. What did irrevocably change during these years, however, was that the organizational integrity of Christendom foundered on the shoals of nationalism and widespread discontent with ecclesiastical abuses. The Protestant Reformation had occurred — from the foundation of the Church of England through the Tudor rule of the 16th century, and Luther 's promulgation of Theses in 1517, to Calvin 's labors in Geneva. Organizational Christianity splintered, without widespread abandonment of underlying convictions. Revelation continued to be a widely espoused belief, even as the depth and breadth of empirical discovery established its beachheads and garrisons.

These movements left considerable relics lying around the intellectual and spiritual landscape, even as civilization pushed relentlessly ahead. It would, in fact, be folly to pretend that the contradictions and complications entailed in the historical drift have been tidied up or solved. These discussions and investigations continue to be very much alive today, and we continue to try to untangle the mess we have made. The core problem, it proves, is that we are niggled by the wonderment that perhaps there were dimensions of the mindset of Cosmos I which perhaps are even more valid, in their own right, than the powerful insights into the universe provided by Cosmos II. But, if that

is so, how do we tease these elements apart and evaluate them? How do we see the universe whole?

Nowhere are these issues stickier or more enlightening than in our changing perspectives on the origin of man. From mid-nineteenth century on, our understanding of evolution has gained depth and momentum. This is a rich vein to mine, since, ultimately, it touches on the profound relationships of spirit to matter. At this point in time — at the beginning of the 21st Century — we have pried the lid off the box, but our vision of what lies within is still uncomfortably limited. We continue to work on it.

Building to Darwin

Working about a hundred years before Darwin, a Swedish botanist named Carolus Linnaeus (Carl von Linne: 1707 - 1778) singlehandedly invented the biological system of classification which is still in use today. He organized plants, animals and even minerals into classes, orders, genera and species. This system appeared in his *Systema Naturae,* published in 1736. His "binomial" (species and genus) system of nomenclature was very rapidly accepted and pressed into service in England and Europe.

As was true of biologists of his time, he viewed species as unchanging. Accordingly, he did not consider evolutionary relationships among live forms as affecting his system of classification. He did, nonetheless, exert great influence on contemporary thinking. He stands as an example *par excellence* of the stage of biological thinking during his lifetime. He was widely educated and experienced, and his mind was crammed full of biological knowledge as it was then available.

The world into which Darwin was born during the nineteenth century had made much progress since Linnaeus' time. Darwin was by no means alone in pursuing a detailed know ledge of biological phenomena. All areas of basic biological science and research made great advances by the time Darwin took up his life work. Although nothing was yet known of genetics or molecular biology, there was a much broader realization of the connectedness of life, and of its patterns of change over time.

Jean-Baptiste Lamarck (1744-1829), French biologist and naturalist was a forerunner in evolutionary thinking, which gradually gained broader acceptance. It is generally taught that Lamarck's chief contribution to biological thought was a discredited theory of evolution, namely that acquired characteristics were heritable. That is an attitude which proves to be prematurely dismissive.

Darwin's Life

Charles Darwin was one of the most influential thinkers of the nineteenth century, and, in fact, of the entire modem period. His importance lies in the contributions he made to evolutionary theory. It is not that he answered all possible questions pertinent to this very important topic. He did not. In fact, in current time there remains a good deal of uncertainty concerning the status of Darwinian thinking. But, there is no difficulty at all in recognizing that Darwin's thought was seminal. He has been a polarity around which thought has swirled pro and con, and his influence is still extraordinarily strong. It always will be, for he broke open the investigation into the evolutionary nature of life on our planet, and that contribution will never disappear.

Charles Robert Darwin (1809 - 82) was born in Shropshire, England, into a privileged and wealthy family. His maternal grandfather was the highly successful pottery manufacturer, Josiah Wedgwood. His paternal grandfather was the renowned physician Erasmus Darwin. After an elite early education, he went to Edinburgh to study medicine. Deciding against that, he went on to Cambridge with the intention of becoming a clergyman. While there, however, he fell under the spell of naturalists, and learned to be a careful and meticulous observer. In 1831 , after graduation, he joined a scientific expedition on HMS Beagle, a British survey vessel. This voyage lasted five years, and became the basis and inspiration for his life's work. As a naturalist, he had ample opportunity to study geological formations on the islands and continents he visited, as well as a great variety of both fossil and living organisms. He became interested in the changes in the Earth's surface that had been brought about by the forces of nature. In Darwin's time, most geologists held the “catastrophist” theory, which taught that there had been several different creations, punctuated by catastrophes. According to this theory, living forms were the descendants of those organisms which had been taken by Noah into the ark. Earlier forms were represented by their fossil remains. Species were thought to be individually created and unchanging. Darwin's thinking was influenced by the writings of Sir Charles Lyell, who rejected the catastrophist theory in favor of a view that the Earth's surface had in fact been constantly changing, as a result of natural forces operating over long time. Lyell, however, generally subscribed to the idea that species had been individually created, a theory which the young Darwin came to doubt. His observation of animal and bird species from one island to another in the Galapagos led him to believe that when isolated from each other, populations had

developed into separate species in response to environmental influences.

Darwin returned to England in 1836, where he set to work on his convictions about the changeability of species. He was independently wealthy, and did not need to work to support himself. After marrying, he moved with his family to a small estate, Down House, outside of London, where he continued working on his projects. By 183 8 he had worked out a sketch of his theory of Natural Selection. These ideas were published in an 1858 paper presented at the same time as one by Alfred Russel Wallace, who independently had arrived at very similar conclusions. *On the Origin of Species* came out in 1859, containing his complete theory. This crucial work later went through six different editions.

The kernel of Natural Selection is that those animals (and plants) which survive to propagate embody natural variations which bestow some competitive benefit. Such variations, however slight, occur naturally in populations. Over time, nature selects for those traits which prove to be adaptive, since the more successful individuals will be those which propagate. This process is the source of gradual evolution. In addition to the central idea of evolutionary process, Darwin also thought that related organisms come from common ancestors, and, on a geological scale, that the earth itself had not been static, but ever changing.

Reactions

These theories, quietly advanced by the sober English naturalist, were in fact revolutionary, and unintentionally

subversive to widely held fundamental convictions about what held the world together. This wasn't how the universe was supposed to be! The reaction to the *Origin* was immediate. Some biologists argued that Darwin could not prove his hypothesis. Others criticized his concept of variation, arguing that he could explain neither the origin of variations nor how they were passed to succeeding generations. This particular scientific objection was not answered until the birth of modem genetics in the early 20th century (and is still problematic). In fact, many scientists continued to express doubts for the following 50 to 80 years. The most publicized attacks on Darwin's ideas, however, came not from scientists but from religious opponents. The thought that living things had evolved by natural processes denied the special creation of humankind and seemed to place humanity on a plane with the animals; both of these ideas were serious contradictions to orthodox theological opinion.

Darwin spent the rest of his life expanding on different aspects of problems raised in the *Origin.* His later books, including *The Variation of Animals and Plants Under Domestication* (1868), *The Descent of Man* (1871), and *The Expression of the Emotions in Animals and Man* (1872), were detailed expositions of topics that had been confined to small sections of the *Origin.* The importance of his work was well recognized by his contemporaries; Darwin was elected to the Royal Society (1839) and the French Academy of Sciences (1878). He was honored by burial in Westminster Abbey after he died in Down, Kent, on April 19, 1882.

Alfred Russell Wallace

A younger contemporary of Darwin's, and scarcely less a contributor to evolutionary theory, was another English naturalist, Alfred Russel Wallace. Wallace arrived independently at almost the exact formulation of natural selection postulated by Darwin, although his reputation has been on the whole overshadowed by that of his more renowned compatriot. The lives of the two great men were not totally dissimilar, and came to be closely entwined on the level of interests and biological theory.

Wallace was born in 1823, fourteen years after Darwin, in Monmouthshire, England. He well outlived Darwin, surviving till 1913. His schooling was interrupted not long after the death of his father when Alfred was still a young man. He joined his brother in doing surveys of the English countryside for four years, an experience which contributed to his skill in making and recording detailed observations. He was appointed to a position at the Collegiate School at Leicester, where he was introduced to systematic botany by Henry Walter Bates, a fellow teacher, with whom he formed a fast friendship. In 1848, at the age of twenty-five, he made an expedition with Bates to the Amazon, where he collected extensive data. He returned to England. Unfortunately, his ship caught fire and all his specimens and notes were lost in the conflagration. He barely escaped with his life.

Another expedition followed from 1854 to 1862, this time to the islands of Malaysia, during which he carefully noted differences between the fauna of Asia and Australia. It was during this period of his life that Wallace, unwitting of Darwin's work, formulated his own theory of natural selection, almost identical to that of Charles Darwin! In 1858, he communicated his theories to Darwin. The two naturalists issued a joint publication in July of that same year. The contribution of Wallace was entitled *On the Tendencies of Varieties to Depart Indefinitely From the*

Original Type. Darwin's ideas had been formulated some 15 years before, but he had held them back from publication out of concern for their reception. Once the joint publication occurred, the idea of natural selection established a place in the development of human thought that time has not erased, although we now know that it is only part of the evolutionary story, not the entire explanation. Wallace went on to publish several more important works, passing on only in 1913.

Herbert Spencer

Herbert Spencer (1820-1903) was yet another British thinker whose work contributed to the solidification and spread of evolutionary thinking. Spencer was mostly self-educated, but he read widely and became an outstanding philosopher and thinker in his own right. He read Lamarck's writing, which profoundly influenced him and opened up his mind to evolutionary theory. His ideas were expounded in his *Principles of Psychology,* published in 1855. Spencer developed a plan for a comprehensive system of philosophy which attempted to incorporate evolutionary theory into other areas of human knowledge. In 1860, he wrote a prospectus of his system which he called *A System of Synthetic Philosophy.* His work received only modest acceptance at the time, but his ambitious effort to systematize human knowledge won him a place among English thinkers of the Victorian period. Although he did not contribute significantly to an understanding of biological evolution, his incorporation of evolutionary theory into mainstream philosophical thinking contributed much to acceptance of evolutionary ideas.

Gregor Mendel

Far to the east of where Darwin lived and labored, another sort of work was being done in a totally different environment, which nonetheless made almost as important a contribution to the understanding of phenomenology of inheritance and descent.

On July 22nd, 1822, Gregor Johann Mendel was born to a peasant family in Heinzendorf, now called Hyncice in the Czech Republic. Note that although Wallace and Mendel lived markedly different lives, they were born within a year of each other. After completing his primary education, Mendel entered the Augustinian monastery at Brunn (now Brno). He had shown early interest in science and succeeded in teaching himself basic scientific principles. For several years, he taught Greek and mathematics as a reserve teacher in the Gymnasium at Znaim. In 1847 he was ordained priest, and lived his life in stable fashion in the Augustinian order. In 1850, he took the examination for teacher certification, but failed. His lowest marks, ironically, were in the section on biology and geology! He was sent by his abbot to study scientific subjects at the University of Vienna. In 1854, he returned to Brunn, where he taught science until 1868, although he never succeeded in passing the examination for licensure as teacher. He was, nonetheless, elected abbot of the monastery in 1868. In 1884, he died, much respected by his community and townsfolk, but without recognition for the highly important work that he did in the study of inheritance in pea plants.

Between 1856 and 1863, as a personal interest, he carried out experiments in the garden of the monastery. He cultivated and tested at least 28,000 pea plants, meticulously and patiently analyzing pairs of plant characteristics.

From this painstaking work, he was able to delineate patterns of characteristics which expressed themselves from generation to generation of plants. He formulated two laws that came to be known as Mendel's laws of heredity. He also coined two terms which have found a lasting place in the science of genetics: dominance and recessiveness, for traits that show up, respectively, in offspring, and for traits that are masked by a dominant gene.

Mendel published his work in 1866, but it did not receive at the time the recognition it deserved. His work and its importance were recognized only in 1900, by different investigators, and its full significance gained lasting attention only in the 1920's and 1930's.

As a result of years of work in population genetics, researchers were successful in describing Darwinian evolution in terms of changes in gene frequency. Mendelian concepts of inheritance, and Darwin's concepts of evolution by natural selection were both developed as phenomenal observations without an understanding of the underlying biological systems which supported them. These were, in fact, to become understood only in light of discoveries made during the second half of the twentieth century, with startling new developments in gene science and molecular biology.

Neo-Darwinism

We are still learning about mechanisms by which evolution might work or surely does; our knowledge is significant, but not exhaustive. At very least, the processes of evolution are immensely complicated. Scientists today — and most everybody else, in fact — are convinced of the fact of evolution: the evidence for it is overwhelming. But the

complete mechanics of evolution continue to be shrouded with much obscurity and uncertainty.

Darwin had a marvelous insight when he “discovered” the principle of natural selection. Since Darwin, we know that the biological world is much more dynamic and internally creative than we had suspected. The great womb of creation, the marvel of an existing universe in the first place, relies a great deal more on the “design” within its supporting structures than we had realized. Darwin had a thought, and a powerful one. But it is far from providing an entire explanation. The mechanism of natural selection is one of those “laws,” which, once identified, is found to be necessary, but insufficient.

Darwin was a keen observer, and a prolific writer. The nature of science, however, is additive and cumulative. We never get there, wherever there is, at once, but by stages and usually a great deal of hard work.

Darwin was a man of his time, as everyone must be. He knew a good deal about animal breeding, which mankind had of course been practicing since civilization's dawn. As a naturalist and a biologist, he possessed a broad observational understanding of inheritance in animals and plants. But, in the middle of the nineteenth century, Darwin had no idea whatsoever about the underlying mechanics of genetics, much less the highly complex phenomena of bioinformatics, the systems by which the basic information systems of biology are encoded and transmitted to achieve biology's complex goals.

In the latter half of the nineteenth century, Darwinian theory established important new biological horizons. With the discovery of DNA and its basic functions a century later, an entirely new dimension of biology was uncovered, which doubtless would have thrilled Darwin, but lay entirely undisclosed to him. Although it had been known for some

time that all living tissue is composed of cells, the full import of this was yet to be discovered. The term “cell,” in fact had been coined by Robert Hooke, in his *Micrographia,* written in 1665, two centuries earlier than Darwin. Hooke laid the foundation for cellular theory after viewing slices of cork through the primitive microscope of his time.

Current work has emphasized that the processes of evolution must take place within the marvelous world of the cell, and, more precisely, within the marvelous world of genetics and the DNA system. At the turn of the century and the millennium, the human genome was mapped.

The combination of the theory of natural selection with growing knowledge and understanding of the internal systems of the cell and of genetics has been termed Neo-Darwinism.

Genetics and Molecular Biology

We know something Darwin didn't: the exact formation of offspring is controlled by the genome, the complex of information and the molecular systems which carry it.

The double helix of the DNA molecule was first described fifty years ago by two Englishmen, Watson and Crick. In 1953, they proposed a model, in which two strands of sugar - phosphate molecules are joined together by base molecules which occur in highly specific sequences. We have come to understand the basic mechanics of genetic control of reproduction. The DNA chain holds the complete blueprint for the formation of a new individual.

Reproductive cells, sperm and, eggs, each contain one of the strands of genetic material. That comes about in the formation of these cells in the testis or the ovary. In the final division leading to the production of these cells, the strands

separate themselves, leaving half of their material in the final reproductive cell. When sperm and egg combine to make the initial cell of a new individual in the species, the two strands unite to provide a complete biological blueprint. The double helix is intact again, with contributions from each parent.

As the embryo goes through the many divisions which gradually build the individual, the genetic material in the DNA is reduplicated in each and every cell, so that the entire code is reproduced billions of times in all the present and future tissues of the organism. In the local geography of developing tissues, this blueprint goes to work and controls the basic chemistry of the individual cell. Cells working together under this genetic control form organs. Ultimately, relying on an interplay between genetic information and the local "politics" of cells proliferating together, the complete organism is formed and comes into being.

The basic operation of this marvelous genetic system is now well understood. The extent of its ramifications is not. There is much about the fine control of the system which, as we move into the third millennium CE, remains as mysterious as it ever was, but we understand the general outlines of the system, and continuing research and study progress with leaps and bounds to fill in the detail.

A Bill of Goods

Classical selection states that the basis for competition is the random variation which occurs among individuals in a species. And that better adapted individuals survive to pass on their genes to their offspring. And that that has been the process by which evolution has occurred.

This was a basic mechanic deduced from the study of birds and other life forms that was arrived at by Darwin and Wallace. It is an extremely powerful insight into one major

aspect of how biological inheritance has to work. The only beings alive today are the descendants of previously successful plants and animals. Variations in animals and plants which were inconsistent with life and survival simply would not live long enough to propagate. Looked at the other way, all of our ancestors (and those of everything alive) were genetic successes. Not necessarily the very best — but at least successful.

The cleverness and lucidity of the principle of natural selection has made a great impact on human thought. There is no doubt that natural selection works. Unfortunately, what has crept into the pattern of thinking is not simply that natural selection works to influence evolution. Too frequently, scientists and lay folk alike have rather gullibly fallen into the conviction that natural selection is the *only* principle operative in evolution. Too frequently, the part has been accepted for the whole. We live in a world of wonders. Those of us fortunate enough to have been trained in the sciences, or to have done the reading to bring ourselves up to speed, are well acquainted with this. The great essayist and all-around ambassador of culture, Gilbert Keith Chesterton, remarked that there is really nothing uninteresting — there are only uninterested people.

One of the minor wonders of our age is the unqualified way in which highly intelligent people have unquestioningly accepted the principles of Natural Selection as providing an adequate explanation of evolutionary process. To restate: the core of this evolutionary theory is, first of all, that there occurs in species a certain amount of natural variation. Then, that the more biologically successful of organisms will be the ones which reproduce. And, finally, that through this mechanism, species will gradually evolve.

That is beautifully simple. Living things show variation. The more successful variations make their possessors more

likely to reproduce. It is clear that it is only the individuals which reproduce that pass on their genes. Thus, from generation to generation the more successful genes are sorted out through this preferential mechanism. It seems, therefore, that nothing else is required to provide for the marvel of gradual evolution. This gradual genetic drift "causes" species to develop over time, and for new species to appear.

The advantage of this theory is its elegant simplicity and apparent universal power. Of course! The guiding hand of reproductive selectivity can be seen to weed out deleterious mutations and conserve for the biological stream the more successful ones. A powerful but clear sort of intergenerational feedback. There are, however, problems with this, and too often it is taken to explain more than it really does.

The difficulty comes in that little phrase "natural variation." Darwin of course had no inkling of the genetic code or the species genome. It would take a century and more for those powerful insights to be teased out of the bedrock of biological evidence. What Darwinian selection omits is an explanation of the *process* by which variation comes about. How is it that not only increased complexity occurs, but increased *function,* possibly of exquisite power and sensitivity? Overzealous supporters of natural selection would tell us that improved reproductive capacity is the controlling, in fact the *only,* engine carrying better adaptations forward from one generation to the next.

Molecular genetics has thrown a lot of light on this, but even that is not enough.

Human Interest

We are of course interested in all realms of biological science: the nature, development, and ultimate destiny of the entire biosphere is what biology is all about. At the end of the day, however, what is most of interest to us is our own existence. Which may be selfish, but not entirely so. In itself, this fleshy computer residing between our ears, is the most unbelievably complex and wonderful phenomenon the world has created. And, that, ultimately, is what a successful theory of evolution has to explain. It is unfortunate that at this time our fossil record of developing brains is as scanty as it is. When nature is left to herself, she does not do a very good job of preserving the remains of individuals in species. Many conditions have to work together to create a fossil record. Mankind had a beginning in time, and we had a distinct line of ancestors which classify into different species, all of which are extinct today, other than ourselves.

To help in our thinking, we can once more recreate the relevant time frames. The earth is old, about 4 ½ billion years old. Relatively, even the dinosaurs are fairly recent. The dinosaurs came into their niche in earth history around 200 million years ago, which is about the last 1/25 of the earth's age. Our earliest identifiable ancestors walked the earth 5 million years ago, or about 1/1000 of earth's age. Our species is identifiable back 40,000 years ago (our older brothers, the Neanderthals, date back about 200,000 years).

Our closest relatives in the animal kingdom are the primates, and, among that genus, the apes. We are not descended from any species of living ape; that is not the way evolution works. We and apes, however, have common ancestors, and not that long ago, either, as biological time unfolds. With the development of genetic biology, it is now known that we share a great proportion of similar genes with the chimps, who are our closest cousins. The lines of descent are not altogether clear, but it seems fairly definite that the

hominids and the pongids (the great apes, including chimpanzees, orangutans, and gorillas) developed separate lines of descent sometime between 5 and 10 million years ago.

"Lucy," classified as Australopithecus, was discovered in 1974 at Hadar in Ethiopia. She walked upright, stood about 3 ½ feet tall, and had a brain size estimated to be about 350 cc. That is about the size of a small grapefruit or large tomato.

A lot of natural history has occurred between Lucy and ourselves. Time seems to grind slowly at times, from the point of view of human experience. In our psychological lives, it seems sometimes as though anticipated goals are never going to be reached. But, that is all a matter of perspective. Animals weren't thinking about much of anything at all — beyond the needs, emotions and activities of daily life — but doubtless Lucy and her family (tribe, pack) were busy enough. What has occurred since that time is an incredible saga, a long and adventurous journey.

The fossil record is tantalizing. We have so much, yet we have so little. The Neanderthals, as we have seen, appeared about 200,000 year ago. Prior to that we have the partial remains of only a hundred or so ancestral animals. These fossils tell us so much, yet there is so much more we would want to know. We will continue to try to reconstruct our prehistoric past, since that knowledge affects so strongly the ways we think about ourselves.

Our brains are what make us human. If there is one thing we would like to know, beyond everything else, it would be the development of that marvelous organ. We can theorize about how that came about, but there is so much information we lack! We have a lot of helpful ideas, but they are like Lucy's skeleton: just a framework on which to build a theory, but lacking in detail.

Increased Complexity, Size and Function

Australopithecus strode the earth from 4 million years ago to about 1 million years ago. Genus Homo had differentiated by 2 million years ago. Homo Neanderthalensis appeared by 200,000 years ago. Homo sapiens sapiens has been around since 30,000+ years ago. Definable culture appeared during this period. The Iceman lived 5,000 years ago. Everything we know of human civilization, the good and the bad, has occurred during the time period since.

There are legitimate questions where and to what extent we have continued the pattern of evolution "upward," since the times all those generations ago when we spread out from our home in Africa. There has certainly been a downside to human progress, and, should we succeed in blowing ourselves away, it would be a legitimate question to ask whether that magnificent history really represented "evolution." But, for the sake of the story, we will assume here that the course of human history has been "upward."

It is worth noting that evolution itself, in a more general way, doesn't always opt for the survival of the species where its processes might appear to have been most successful. What if, like the sabertooth tiger, our evolution were to fit us for a particular niche, but the very success of our advance were ultimately to make the home niche an increasingly uninhabitable one?

We have to leave that one on the shelf for the moment, but it is worth resolving that we should do what we can to assure our survival over the long haul. In the meantime, we need to continue to try to identify and understand the process. Relative to individual experience, our cave man

days seem long ago. Relative to change in the cosmos, the development of the human brain has been an explosive phenomenon. Let's do some rough calculating. Over the last 1,000,000 years the brains of hominids have increased from about 900 to 1400 cc in size, or roughly about 500 cc. The human brain is immensely dense in its organization, containing, on average about 10,000,000 cells per cc. During that million years, there have been about 50,000 generations of the species, give or take. That means that, *on the average,* our brains have increased by about 100,000 cells *per generation.* And, that's not in exceptional individuals. That's the racial *average.* This is certainly very sloppy biology, but it underlines one thing: our evolution has been incredibly rapid, as natural phenomena go. This is not advanced as a scientific datum. Rather, it's a manuduction, a beckoning towards understanding. If you don't like my numbers, change them here and there by an order of magnitude, and the overall result remains unchanged.

As phenomena in an evolving world go, the brain has increased its average volume at a remarkable rate. Not only is there a huge increase in size and cell count – other animals have large brains, too – more significantly, the functional change has been even more astounding. As we added size and complexity to our brains, so our bag of cognitive and behavioral tricks has more than bounded ahead. We have added all those things which make us distinctively human: full bipedality, the opposable thumb, a smaller and differently oriented face, language, culture, religious development and metaphysics, art and creativity, and, during the last phase of this marvelous adventure, a very successful assault on the natural world via the sciences.

Random Mutations and the Tooth Fairy

We have lived with general evolutionary theory only for a hundred and fifty years, or two hundred at the outside. The field turns out to be much more complicated than it seemed to be at the start of the project. In order to make the first major inroads into the area, certain prejudices and philosophical convictions had to be overcome; or, if not overcome, at least stepped around. This general phenomenon is more true in evolutionary theory than just about anywhere else in the vast realm of scientific discovery. It is not hard to understand why this is so. The cultural reason why the investigation of evolution has been psychologically difficult is that it threatens to undermine many of our most closely held preconceptions about ourselves and our lives.

The early giants of evolutionary thought, Lamarck, Darwin, Wallace, Spencer, and, though rather unconsciously, Mendel, wrestled with the facts of evolution in bulk form, so to speak. They became convinced of the general shape of brute phenomena, and developed theories to explain the major thrust of their insights. They were much less successful in elucidating details. Not to be wondered at: they could attack the problem only from their current positions. Of course. That's always true. But, they little suspected the complexity of the phenomena they were trying to understand.

A successful theory of evolution must explain not only the broad outlines of phenomena, but the internal dynamics. The most marvelous product of evolutionary process is, by many orders of complexity, our own brains. Our way of knowing our environment is exceptional. A successful theory of evolution needs to explain not just the external shape of our advance into higher consciousness, but its internal process mechanics. How is it that this highly

complex organ with which we think and experience has added on the structural and functional components required to support our specific awareness and intelligence?

A couple of things *won't work.* To claim that these human changes have been preserved and encouraged because of their contribution to the reproductive success of our ancestors, and to think that that explains the highly complex phenomenology is magical thinking. It is an inadequate explanation to say that random genetic mutations produce a range of phenotypes, and that the brain has evolved because more successful individuals have been more successful reproductively. That leaves out way too much of the detail. If there is any truth to this conceptualization, it is at best only part of a very complex story. Blindly hanging everything on this formulation, and asserting that this provides a complete explanation, is tooth-fairy theorizing. The capacity to reproduce doesn't take the huge panoply of skills and functions that the development of a conceptualizing brain entails.

To try to explain brain evolution by a systems theory of complexity production won't get us there either. We need to go beyond a theory of genes and molecules, and introduce some specific understanding of how it is that a Mozart sonata can happen, and how it is that there can be a mind capable of pursuing the theoretical specificities of quantum mechanics. These phenomena are not simply the result of random mutations, nor is it enough to claim that we hold onto them because they make their owners more successfully reproductive.

Accounting for the Brain

Thought and culture are not in themselves carried in the physical genome: but the capacity to produce these phenomena is. The development of our brains and our specific functions could never have been produced simply by random mutations, nor preserved because of their reproductive value. Something else is afoot. What it is and how it works is the quarry of our adventure.

As the human brain developed, from generation to generation, and over the centuries, its capacity to support more and more abstractive function increased. That functional increase is at the core of human existence. Therein resides our spirituality and our entire ability to act specifically as humans. Consciousness is an epiphenomenon to brain activation. That at this point is a postulate, but it is an important one. A very important part of the puzzle, then, at that point, becomes figuring out what the nature of that brain activation is, and how, through evolutionary process, it came about.

Our brains are clearly an extrapolation from the brains of other animals. And, it seems beyond challenge that, first, we have enlisted the brain functions of other animals for operations of which those animals were incapable, and, second, we have added on operations far exceeding those found in our animal brethren. Our brains are like those of other animals — but different. All the major divisions in the mammalian brain have their analogs in the human brain, and, in fact, it works the other way, too. There are no fully novel portions of the human brain. Nuclei and tracts which support our modalities of intelligent consciousness have their analogs in the brains of dogs, horses, and mice. Development and function are, however, a great deal different.

Evolutionary theory has to account for this wonderful development. Saying that nature selected for it because of

its preferential reproductive value just doesn't cut the mustard.

Seminal Thinkers

Lamarck and Darwin – as well as other less eminent biologists – had become convinced of the general success of evolutionary theory. Lamarck thought that the acquired characteristics of animals could be transmitted to their offspring, and that that was the way evolution could occur. Darwin emphasized that gradual variations could be selected on the basis of their value for reproductive success. Of these two approaches, Darwin's theory has clearly won greater acceptance and in that sense has stood the test of time. But, as we have seen, particularly in the instance of highly complex processes leading to new plateaus of function, natural variation is a weak tool for explaining how specifically more powerful and more generalized functions might come about. The problem remains of explaining how one level of complex function could serve as the foundation for yet more generalized function — unless, that is to say — it might be possible for the experience of the individual to have an effect on the genome itself.

The “discovery” of the principles of natural selection by Darwin and Wallace was an important step forward because it showed how an acceptance of individual creation was not necessary. God had not created things as they appear. If the concept of God in an actual universe is a meaningful one, it does not imply that God tinkers around with making things directly as they appear. The world is a developmental place, and there are underlying principles and mechanics which create the complex phenomenology of the here and now. Not only was the theory of individual creation unnecessary, it

was widely off the mark. The Darwinian insight pried the lid off the box of creation and showed that there are marvelous internal workings which make the thing go. Not only is the universe interactionally causal as we look at it. It is also developmental and internally dynamic. Things got the way they are by evolutionary rules.

Once things are developed in the biological stream, they need to find their way into the reproductive marketplace if they are to survive. Unless things can get carried on to the next generation, they will not continue to see the light of day. Life is a great and wonderful symphony. But it is one that writes its own score. Once this is realized, it opens up the study of reality to entirely new dimensions. The understanding of nature is an entirely new and thrilling adventure. A study of the actual world in which we live moves from not only that it is, but, more importantly, to how it works, and how it got to be the way it is. This is putting the thumb of the mind on the actual pulse of creation.

No Evidence or Explanation for the Variation

Wonderful insight! What Darwin observed is something we absolutely needed to know, even if it threw many of our cherished beliefs onto the trash heap. But it is a serious mistake to accept that the theory of natural selection explains the entire process. It is part of the shape of the story, but not the entire tale, by any means. It is true that variations will tend to be preserved in life forms if they contribute to the capacity of individuals to reproduce.

But at that point, what needs to be explained is how variations come about. That may be an entirely new set of concerns, and the horizons that that question opens up may be quite broad and diverse. Natural selection as a theory

simply states that among populations, there will be a certain range of variation. Which is certainly true. Frequently, it is assumed that a theory of random mutation is enough to explain for the actual variation among individuals. But that is nowhere near enough. For one thing, most mutations we know of are deleterious to the individual rather than beneficial. The concept of spontaneous mutation that is creative is a shaky one. Even more, patterns of consistently creative spontaneous mutation are pressing biological luck even further. Winning the lottery is fun, but you can't continue to win every time there is a drawing.

What evolution needs to explain is the process by which variation occurs. Or, more appropriately, the systems of process. It is not apparent at all — nor, in fact, does it end up being true — that there is only one process involved. Certainly, spontaneous mutation is a very weak tool to explain a complex set of phenomena. Life is immensely rich and varied, and it turns out that there are many processes, and many ways of recording process.

The finding of fossil remains of the precursors of our race has been crucial to the development of our understanding of our own evolution. Yet, the evidence that we have is tantalizingly sparse. We cannot help but wish that we had a much more complete picturebook than we actually do. This is why new discoveries, which continue to be made, elicit as much interest as they do. Since the picture is so incomplete, each specimen can be so important. A thigh bone in Ethiopia, or a mandible in Hungary, can change overnight our understanding of entire chapters of our racial development. Exploration and findings will continue, and we will continue to expand and modify our knowledge and theory of how we developed. What made the discovery of Lucy so remarkable was the completeness of her remains,

and the clarity her discovery provided of the state of evolutionary progress three million years ago.

Populations vs. the Generalized Model

It is not clear whether any of the hominid fossil remains we have discovered are in our direct line of ancestry, or whether they represent collateral populations. One of the major frustrations about the available evidence is that we have spans of what appear to be fairly stable populations, rather than sequential populations which clearly demonstrate the evolutionary process in action.

There is no least doubt about the fact that all hominids are closely related genetically. There is no doubt that we have a continuous hominid ancestry going back to the point at which all primates separated from other mammals. So, we would have to postulate that if we had a magical camera capable of transcending time, we could fill a family photo album which would include an ancestral line with no gaps in it. That seems fairly evident. But, it seems unlikely that we will ever in actuality find the fossil remains of such an uninterrupted line. The odds are strongly against it. First of all, the simple numbers make it extremely unlikely. There are probably 300,000 to 500,000 members in that family. The likelihood of finding such a cascade of remains is slim to none. But, a mechanism prevails which goes beyond the simple accumulation of numbers.

When populations split off from the general line, they tend to form groups that are more or less stable. These groups tend to develop specializations. Once specialization occurs, it is unlikely that such animals will be able to continue the process of evolutionary change. Continued evolution presupposes generalization. However, the more

generalized forms which keep open the possibility of further evolution are most likely not to be the most numerous populations. Relative to the total number of ever existing hominids, it is likely that the evolutionary line is a relatively small number.

Little Lucy – Prospectively Human?

What about our little Lucy? Is she or is she not likely to be a direct ancestor of ours? We will probably never know with certainty. But it is likely that she stood close to the evolutionary line if not directly in it. Lucy stood about 45 inches in height. She was definitely bipedal, which alone would earn her a place on the evolutionary team. Was her hand more simian, or did it clearly have an opposable thumb? That is not altogether clear. Perhaps that differentiation had not yet occurred. Her brain lacked the cortical development and growth in size that would become evident once the fully humanoid line became established. What seems evident, however, is that Lucy had not gone the way of specialization evident in the later pongid and simian lines.

Had we been able to meet and study Lucy, it is likely that we could tell that she would have looked — well — strangely ancestral. She would have shown traits that would have appeared to us to be not exactly human, but at least pre-humanoid. We would probably have been able to tell that Lucy, strangely enough, was headed our way. This raises interesting questions, ones that we cannot answer in the Lucy context, but nonetheless underlie in a certain way the entire project we are pursuing.

If it is true that Lucy, strangely enough, was headed our way, then in what sense were we “contained” in the matrix

of possible outcomes manifested in Lucy's form and function? Was there, in Lucy, some – any? – prescient plan or design? If we existed, potentially, in Lucy, was our reality in any way "intended" by Lucy's reality? And the question entailed by all of that, is there intentionality in the universe? and if intentionality, consciousness outside ourselves? Somewhere and somehow, there have to be answers to these questions. They are questions we will continue to ask, constantly, until we have answers which will satisfy the most demanding of questioners. By the end of this book, we will have considered *some* answers, though mysteries will remain, notwithstanding.

Endpoint — Cosmic Understanding

Assuming that Lucy stood in the center of the evolutionary stream, or at least close enough to it that we could accept her as a meaningful facsimile, what about her mind and consciousness? Doubtless she perceived and "knew" a lot about her surroundings and the world in which she lived. She (and her brothers and sisters) knew enough to stay out of the clutches of predators at least well enough to survive and propagate. Could she make noise? Doubtless. Could she talk? Doubtful, in the extreme. Could she fashion and use tools? Not very likely, although, like certain pongids of today she could probably use some tool-like things opportunistically.

Was her 400 cc brain capable of symbol formation? If so, it was rudimentary at best. But was she as smart as a chimpanzee of today? Almost certainly. But, what was most important was the fact that, in addition to being a "pretty smart animal," she was en route where our heads are today, and where our descendants' heads will be in one or fifty generations down the road, assuming we (the race) should

live so long. Since it's not either proved or probable, we will postulate that this little sister of ours from times remote was *in via* with respect to language, literature and cosmic understanding. Reprising observations above, this would mean that Lucy's brain was successfully staying generalized, so that it could continue to evolve, even though it might not have been quite as well *adapted* to her environment as well as some of the other animals alive at the same time she was.

This leads us to query, if Lucy was at a given stage, and we are at a later stage, and if this establishes a line of forward movement, what would be, what will be, the endpoint of this process? It would seem as though the psychological endpoint of the process would naturally be an exhaustive understanding of the universe itself, which is sort of a scary idea, perhaps equal to, or exceeding the knowledge of Good and Evil that got Adam and Eve, in that fable, into such enduring and irritating trouble. This is Pandora peeping inside Hephaistus' magic box. Where are we when the anticipatory intelligence of Lucy achieves a maximum, if that indeed is possible?

Information Reverberation

What is happening here is something Lucy couldn't do – something homo erectus presumably couldn't do, at least to any significant degree. Homo neanderthalis probably wasn't up to it either, from everything we know. Looked at from the perspective of knowledge and information in themselves, what is happening is awareness not focusing on the environment in which it finds itself, but on itself, its extent and its history. This is personal reflection, but it is more than that. It is reflection on reflection itself. It is brain function functioning on its own function, if you will. This is

something marvelous in itself. It also presupposes and depends on a marvelous application of brain function. Surveying the animal kingdom, it seems beyond doubt that this is a unique and special phenomenon, and one that we need to account for in our theory of evolution. This is peeking into Hephaistus' box in a very special way, one that may engender in the Olympian entourage a degree of reproach and trepidation. But, not one that we, any more than Pandora, are likely to tum away from, since this is the quintessential thread of life itself!

It taxes our credulity to believe that the information reverberation we are here tossing back and forth from one mental hand to the other, studying it, is the simple result of random mutations which contributed to a more assured reproductivity in among the evolving family of our ancestors. Not likely. Our ancestors held onto the openness and plasticity of the evolutionary stream time and time again even though they were not as well adapted to survival as lines that deviated off and became more specialized.

They somehow refused to close the book on specialization quite at the expense of more successful reproductivity. They couldn't do any particular thing as well as animals around them. Assuming we are on track in analyzing the development of things, the only thing they did better was to hold open the capacity for evolutionary transaction, and in doing that, they were almost certainly in the minority.

This demands an extremely high level of “generalized specificity.” Or “specific generalization,” however you might want to look at it. The likelihood of this being the result of random mutation of the genome is zero.

Inheritance of Acquired Characteristics

Teleological thinking has not proved heuristically helpful in the area of understanding the evolution of the human animal. To clarify, it has not been helpful to speculate about the reasons why nature has chosen this rather than that. In most instances, it is not helpful to ask whether nature has in mind a plan, or whether purposefulness is manifested anywhere else than in the areas of our own planning and function. And yet, on a metalevel, we are faced with this odd realization that our brain functions are a surprising expression of the possibilities of the insensate world of atoms and molecules. In the limited sense that possibility of the development of mind is somehow contained with the capacities of matter, matter somehow "intends" us.

Even though teleological thinking is not heuristically helpful, we will still need ultimately to deal with the problem of plan and intentionality in the universe. But there are other considerations more to hand. How to deal with the complex phenomenon of an evolving brain that layers onto earlier functional levels yet more complicated and powerful strata of structure and function? As Holmes observed, when other possibilities have been excluded, what remains as the only remaining explanation must be entertained, no matter how seemingly improbable.

In our evolution, there seems to be intrinsic value in increased consciousness and cognition, not separate from, yet not fully explained by, whatever survival benefit it may confer. There seems to be a range where nature opts for increased function because it is somehow "better." The organism seems to "like" being smarter, independent of its survival value. On a broad plane, it does seem to be true that the reason our race has penetrated into so many biological niches has been our peculiar way of knowing and coping

with ourselves and our environment. More narrowly, it is by no means clear that our intelligence made it any more likely that we would survive than any number of other life forms. And, if natural selection provides an adequate explanation for intelligence to be selected, it would be necessary that it contribute to survivability on the level of the individual.

A Discredited Theory

Pangenesis is referred to in the literature as a discredited and false theory of evolution. It is a theory proposed by Darwin in one of his later and lesser works, *The Variation of Animals and Plants Under Domestication.* Here Darwin becomes quite Lamarckian, struggling with what he felt to be clear evidences of the inheritance of acquired characteristics. Many writers seem either to be unaware of Darwin's thought in this area, or to be inclined to see it as a fleeting aberration in the master's thought processes. A feeble idea on a bad day. No matter.

Since it has a great deal to do with our thought here, Darwin will be quoted verbatim.

"How, again, can we explain the inherited effects of the use or disuse of particular organs? The domesticated duck flies less and walks more than the wild duck, and its limb bones have become diminished and increased in a corresponding manner in comparison with those of the wild duck. A horse is trained to certain paces, and the colt inherits similar consensual movements. The domesticated rabbit becomes tame from close confinement; the dog, intelligent from associating with man; the retriever is taught to fetch and carry; and these mental endowments and bodily powers are all inherited. Nothing in the whole circuit of physiology is more wonderful. How can the use or disuse of a particular

limb or of the brain affect a small aggregate of reproductive cells, seated in a distant part of the body, in such a manner that the being developed from these cells inherits the characters of either one or both parents? Even an imperfect answer to this question would be satisfactory."

The Variation of Animals and Plants Under Domestication
Chapter XXVII Pangenesis

Darwin very clearly struggled with the same demon that has pestered us here. Having seen and dealt with the power of natural selection, he then went on to be bothered by its limitations. Darwin became distinctly non-Darwinian. This tendency seems usually, if recognized at all, to be written off as a momentary aberration in the thinking of the great naturalist. Even Homer nods, or so one might think.

In trying to see where to go with this intellectual itch, Darwin thought up the idea of *gemmules,* or small packets of cells which he supposed to generate from all organs of the body, and to carry the information of acquired characteristics back to the germ tissue contained in the gonads. If such a phenomenon could be identified, then an explanation could be provided for what seemed to Darwin to be an important problem.

Darwin's cousin, Francis Galton, became intrigued with the gemmules idea and entered into a series of experiments by which he attempted to demonstrate it. He spent a considerable amount of time transfusing blood from one rabbit to another to see whether thereby he could induce the effects of experience in naive individuals. Needless to say, it didn't work, and he eventually abandoned his efforts. Nonetheless, this may be instructive.

Affecting the Genome

Natural selection would not seem to provide an adequate explanation for the evolution of man. There is no evidence that, along the way, intelligence would have been selected for because it provided reproductive dominance. But, more importantly than this, natural selection provides no explanation for how the incredible increase in cerebral complexity and functional capacity might occur. Ascribing "random variation" as a causal explanation is unsatisfactory; that begs the question. The steady forward march of neural complexity is too successful a process for it to be the result simply of biological chance. We are forced into looking at the possible relationship between experience and the genome. We are fairly well convinced at this stage of our thought that the biological "trick" that would have to occur is the transmission of the result of experience from the somatic cells back to the gonadal genome, since that is the only way that changes can be handed on to descendants.

During the twentieth century we increased our understanding both of living organisms, and also of the processes of information handling in general. It became evident that information management and transmission within complex animals — and even more so in humans — is both pervasive, and also multiphasic. There are no organs or systems in the body which are not both cause and effect of information originating and transmission. Life is a complex matrix of interactive information and communication systems.

There is no reason to conclude that the only information system affecting inheritance and evolution is the relatively crude intergenerational feedback of natural selection. As a theory, that has the advantage of simplicity, to be sure, but

if the theory is too weak to support the phenomenology, we need to look to other possibilities. What occurred in the evolution of the brain over the last few million years is staggeringly complex. The ultimate theory we end up with needs to account for this complexity in highly specific ways. We need to know just how this complexity emerged. At our current level of understanding, our knowledge is still incomplete and partial.

The problem is one of information coding and transmission. We know that a living organism is a complex system of nested and interrelated information systems. We need to study what we know to be the actual information systems of the body if we are going to come to an understanding of how the evolutionary process might occur.

Nervous System

The clearest instance of information management and transmission in complex animals is the nervous system. The brain, spinal cord and peripheral nerves are dedicated to and mediate reflex reaction as well as consciousness, and bring about communication from and to the distal portions of an animal body. Our understanding of the details of these fundamentals remained quite primitive until well into the twentieth century.

The operation of the nervous system depends on its macrostructure: the brain, the spinal cord and the peripheral nerves. Each of these has structure and function on these levels. Each is composed of the constituent living tissues which form the several organs. Below that level, all the structures are formed of cells, which have their own functions and their own management systems. Within each cell are many thousands of functions and operations which

rely on the intracellular organelles and, ultimately, on the organic and inorganic structures and functions which make them up.

The entire system needs to work together in a harmonious symphony of cooperation, if the larger organism is to live its life successfully. The wonder is how marvelously effective and efficient these systems are. Most of the detail of our knowledge in these areas came to light during the twentieth century. As we went into that period, we were still describing things on a crude level. And it is not as though we have as yet come to the end of this. We have worked out much of the seeming magic by which nerve transmission occurs and the different basic functions of psychology are mediated via the nuclei and tracts of the brain and spinal cord, but there is still much that is mysterious about the ways in which experience is integrated, and how personhood and individuality emerge from the marvelous networks of cellular activation.

Endocrine System

We understand many of the general principles of the transmission of neurological impulses along the highways of the brain and nerves. The functions of the ductless glands of the body have also become widely understood. As a generality, these tiny organs control broader and less immediate operations of the body in development and in response to life stimuli. The thyroid regulates the basic metabolism of the body. The hypothalamus at the base of the brain affects growth and many aspects of sexual maturation and function. The gonads, in addition to producing sperm and ova, also induce many aspects of sexual maturation and function. The suprarenal glands are capable of pouring large

amounts of adrenaline into the general circulation at times of stress or threat.

Taken together, the endocrine hormones are mediators of pervasive communications that widely influence growth and the specificities of development and function. Most of the time these systems function quite adequately, although they are all susceptible to pathological alteration in their specific disease states.

Topographical Modulation

Cells and intracellular components work differently depending on where they may happen to develop in their local environment. The capacities of cells either to halt further growth or continue it are modulated by sensitive feedback mechanisms which are only poorly understood. These systems need generally to be under the regulatory direction of the genome, but how that occurs is quite obscure.

When organs are being formed in a developing embryo, the differentiation of their cell populations is exquisitely sensitive. Cell types are generally determined, but the exact expression of their possibilities is frequently directed by the immediate physical environment. For instance, the tissues which go to create a nose include bone, muscle, cartilage, connective tissue, skin, blood vessels, and nerves. How the cells “decide” which to tum into and how they should be located is presumably under the direction of nuclear and mitochondrial DNA, but fine modulation apparently is controlled by physical and chemical gradients. Such variables as proximity to circulation or to structural elements appear to be implicated, though through mechanisms that are poorly understood. The system is so

finely tuned and precise that organs, like noses, can frequently be identified in their similarity to their parents'. The nose may be “just exactly” like mom's or dad's, or even like Aunt Sally's. We are only beginning to develop insight into the workings of these systems. It is a good deal clearer *that* they work than just exactly *how*.

Molecular Biology

The nervous and endocrine systems are major elements in the body's communication systems; they rely on structure at the level of organs for their function and effectiveness. They also carry out functions on the molecular level, on a physically much tinier scale. And in that regard, their function is similar to much broader systems which operate on the sub-cellular level. The role of proteins and protein moieties has become clearer particularly over the last few decades of the twentieth century. We know now that most of the body's basic functions are influenced and mediated through the physics and chemistry of molecular events. The genetic code, which operates at the very core of development and function in health and disease, transacts its business on the biomolecular level.

Within the cell, much of the specificity of protein manufacture depends on the coding and transcription of information carried in the DNA. The messenger RNA picks up coding from the DNA and transfers the contained messages to the intracellular organelles which then go to work to produce the precise proteins and other biological molecules which the cell requires.

The immune system has as one of its prime functions protection from outside invaders, particularly those of viral and bacterial origin. The lymph glands are primarily

involved in this highly important system, without which the larger organism would succumb to infection, and could not survive.

The challenge of AIDS, the most devastating epidemic to strike the human race in recorded medical history, is its attack on the immune system in ways that the system is not prepared to fight. The body is severely limited in its ability to produce antibodies to the AIDS virus. The most probable reason for this is that the virus developed and had its primary host vector in non-human species, and only was introduced into the human population relatively late in the game. Humans have been relatively naive, therefore to this attack, and hence relatively weak responders. We do much better with invaders to which we have had longer exposure.

Nerves, Glands and Molecules

The reason for including an overview of communication systems within the body here is quite specific to our discussion. Our interest is comprehending evolution at this stage in our knowledge. In the light of what we know today which Darwin and Mendel didn't, how is it likely that the basic mechanics of evolution work? And, specifically, what *else* about evolution do more recent discoveries in biology suggest? Is natural selection, whatever its elegance and power, the controlling mechanism in evolutionary process? I suspect not, at least in a strict Darwinian sense. I suspect there is more to this tale than appears on the surface.

This becomes now more speculation than otherwise. Unfortunately, I am not in a position to participate in the scientific study and investigation which these concepts suggest. No matter (he said dismissively)! Advance in understanding is very much a shared venture. Either these

thoughts will have a place in the ongoing discussion, or they will be discarded as irrelevant and useless. I can live quite contentedly with either outcome. But, in terms of the development of my own thinking on these matters, I was at the point of considering what part molecular biology might have to play in the evolutionary drama when I discovered that Darwin, sly fox, had been there before me. It was then that I stumbled into his speculations about pangenesis and gemmules. And, as Darwin himself said, “Even an imperfect answer to this question would be satisfactory.”

Complexity – Ultimate Textbook (21st Century)

By the beginning of the 21st Century, we have mapped the human genome. This but a short time ago would have seemed an impossibly complicated and distant objective. The key to the significance of the genome is bioinformation. Starting with Crick and Watson's identification of the complex DNA molecule 50 years ago, we have been striving to understand the ways in which the blueprint for life is coded in the sequences of sugars and bases. Slowly we have penetrated into the secret messaging systems of life. Given the relative recentness of the discovery of DNA and the novelty of the systems this opened up, we have made considerable progress in deciphering the language of genetics and the way that the coding exerts its effects in the biological environment. Yet, we have a long way to go.

The advances in understanding the physical world made during the twentieth century tower high: relativity, atomic physics, quantum mechanics, black holes, and on and on. It is natural enough to wonder what further discoveries are in

the wings. Will the rate of discovery continue? How far can we go in understanding our universe? It is not too much to expect that one of the things we will not only crack open but understand exhaustively is the complicated mystery of bioinformatics. Beyond that, there are certainly other horizons we hope to push back, but the key to understanding evolution is the understanding of biological information systems. The textbooks written by the end of the century will be widely different than the textbooks in use today. One of the textbooks we will write before long is the ultimate textbook of Life Science. We cannot do that yet, but we are in a far better position than our parents were to imagine what it would be like.

Synergistic Cognition

It is an anthropocentric question, to be sure. But, our interest, ultimately, is the place of mind in the universe. And, it may eventuate that this anthropocentricity is not a selfish thing after all, since it calls into question the most fundamental and pervasive mysteries of all creation. If our understanding of evolution is correct, it follows that cognition and the brain structure and function it has taken to support it is not only the result of evolution, but has been operationally contributory to it. And that in precisely definable physical ways.

From the bottom up, so to speak, there has been operative synergy between structure and cognition, so that neither is possible without the other. Neither of these is capable of explanation in terms of itself, without consideration of the other. The interaction between matter and mind is not incidental. Rather, it is critical to the natural history of both. Cognition is synergistically creative. Curiosity turns out to

be a major dynamism for creative change in the universe, if our speculations on the mechanics of evolution turn out to be true.

At the beginning of the Western intellectual enterprise, Aristotle remarked that by nature, each man desires to know. He saw this as a matter of direct observation. He realized little, however, how profoundly this is true, and how deeply into the processes of life and evolution the urge to know penetrates. This curiosity, which seemed so natural to Aristotle, ends up being positively contributory to the process of evolution itself. In that sense, curiosity may prove to be the critical engine driving evolutionary process, rather than random mutation.

Evolutionary Hypothesis

At long last, we are at a point where we can formulate a hypothesis as to how it is that evolution *really* works. We have been saying from the start that natural selection, a la Darwin, is too weak a tool to explain the complex phenomenon of evolution.

The paradigm of the process for us has got to be the development of our own brains. That is the locus of the most complex evolution which, as far as we know, exists anywhere in the cosmos. Grantedly, that's a rather bold claim to make, and perhaps somewhere there is a natural phenomenon more wonderful and more complex than the human brain. But, our suspicion would be that if there were, it would probably be the brain of some other species on some other planet capable of sustaining life. And that would only interest us the more. In any event, if we can explain how our own brains came to develop, we can probably explain any other example of evolutionary complexity.

The simplest reason why we rejected natural selection as the chief and *only* mechanism of evolution is that, as we study the development of intelligence, it is not at all clear that it across the board contributes that much to survivability and reproductive success. It seems that many other species did quite well in those areas without the benefit of high intelligence. Down the road, we have clearly become (for the time being) the dominant species, but we are also very late players in the game, and species certainly didn't wait around until we got here to survive and propagate.

Too, we have stated that natural selection, as a theory, fails miserably to explain the specificity and complexity of biological development. What is it that guides the organism in laying down the highly specific circuitry involved in growth in cognitive capacity? If this were to be the outcome of random change, how could it be that the change is so effective? How is it that the organism “knows” how to grow the cells, tracts and nuclei which are specific to human knowing? How is it that the brain ends up being so marvelously adapted to experience? And, not just any old experience, but the specifically abstractive cognitive experience that makes humans human? For things to tum out this way by chance is simply impossible. To get there by reproductive benefit conferred by chance mutations is impossible. There needs to be another explanation.

The reason the human brain is so marvelously adapted to the world around us is that it has been forged on the anvil of experience.

Brain Response

Lamarck is generally tossed aside onto the scrapheap of science's history. After, that is, a passing recognition of his

energy and contribution to the general field of biology. Lamarck was convinced that species could change through evolutionary process. He advanced the theory that under certain conditions the experience of adults in species could be passed on to their offspring. His ideas were mostly discarded because, first, he could not demonstrate through experiments that this happens, and, second, he could advance no probable mechanism to explain it. Darwin, after all the work he did on natural selection, came back, as we have seen, to the idea that in some instances, natural selection wasn't enough. The problem, of course, was — and is — if the effects of experience can ever be passed on to offspring, how could that happen? Darwin tentatively advanced the theory of "gemmules," but, for lack of evidence, the idea never gained acceptance.

Lamarck and Darwin knew nothing about the underlying mechanics of reproduction, although they both were well acquainted with the phenomena of breeding of animals and plants, which had been a part of farm husbandry since the stone age. But, it took until the 2nd half of the twentieth century, after the identification of DNA and progress in the science of genetics, for the mystery of inheritance to be cracked open. In these pages, the conviction has been expressed, along with Darwin's musings, that natural selection is, indeed, inadequate to account for the world we know, and of which we are a part. In particular, it has seemed that the specificity and complexity of the structure and function of the human brain are simply too high and too steep a mountain for the engine of natural selection to climb. But, if we wish to advance that theory, it falls on us, too, to give a likely account of how that might happen.

The first step that needs to be established is that, as it grows from infancy to adulthood, the brain is highly and importantly susceptible to responding physically to the

experiences of the individual. Although these changes are difficult to demonstrate experimentally, it is clear from many different areas that this is true.

Humans who are deprived of sight from early life due to some deficiency in the eye have underdeveloped optical cortices, which are to be found at the very rear of the brain (occipital area). This is because the maturation of these brain areas was not stimulated by the experience of sight. If a structural defect is later corrected surgically, so that impulses reach the cortices, the individual still cannot “see” normally, because the neuronal connections had not been made when they needed to be. In certain laboratory experiments, working with mice, the cortices of the brain are actually measurably thicker in animals raised with enriched experience as compared with experience impoverished mice.

There is truth in the old adage that you can't teach an old dog new tricks. We usually use this saying to refer to ourselves rather than our pooches — meaning, broadly, that you had better learn something as a youngster rather than later on, if you wish to be really proficient in it. This is not just a psychological fact; it is one with a solid basis in physiology. Experience to a notable degree affects not just the function, but also the structure of our neurons, nuclei and brain tracts.

The other arm of the theory needs to expound a mechanism by which the results of experience (in this case, in the brain) might be communicated to the gonadal genome. It wouldn't do any good for there to be local educated proliferation of brain tissue if our ovaries and testicles couldn't “find out” about it. We have pointed out that the organism is a vastly complex matrix of communication systems, at a level we understand moderately well as a result of the work of the last decades. Nothing happens in our bodies without the reception and transmission of

information on many different levels, though many different mechanisms.

We have pointed out the major ways in which communication occurs: the central and peripheral nervous systems, the endocrine system, topographical modulation, and the marvels of molecular biology. There are two points which are worth making. First, there is no compelling evidence that natural selection is the only mechanism of evolutionary change. Second, there is no convincing evidence against the inheritance of acquired characteristics. Beyond those points, the discussion becomes speculative.

We can make a distinction between phenomena which are close to the core of the evolutionary process, and those which are more towards the periphery. There is no clear line between these two areas. But, the core processes would have more to do with the basic formation of organ systems in the developing embryo and their biological governance in the adult. The peripheral process would have more to do with the operations of already formed organs in already developed individuals in a species.

It may well be that phenomena towards the periphery in this rough division are less susceptible to affecting the genome through experience. Thus, expecting the tails of sheep to be short at birth in breeds that have had their tails docked for hundreds of years would be a fruitless anticipation. It would be more likely for cave dwelling lizards which never see daylight to be born blind after many generations. It would not make sense or be necessary to suppose that such an adaptation would be selected because of an increased reproductivity.

Evolutionary Hypothesis

The development and growth of the brain over many thousands of years, as has occurred in hominids, and ultimately man, would be a core phenomenon rather than a peripheral one. The hypothesis I advance is that the human brain developed in close conjunction with the experience of using it, and that that is the only thing that would account for the exquisite adaptedness of the brain to perceive and finally to understand its environment. The trick and the question is how experience in individuals can be transmitted back to the generative genome. If the brain can develop in response to experience (as it certainly does), how can the gonadal DNA ever get to "know" about those changes and gradually change its coding?

I do not have empirical data to support any specific answer to these critical questions, and it is clear that before we could lock up our theory about evolution, we would need exactly that kind of data. But, looking at what we know about the internal communication systems of the organism, what would be possible on a theoretical level? There is no clear way in which the nervous system or the endocrine system could be involved in the process. These systems would appear to have a specifically local effect, and not to have an obvious manner of affecting genetic DNA. Which wouldn't totally rule them out, since the more we know about these systems, the more we realize that our knowledge, though extensive, is incomplete. The process referred to here as topographical modulation would not seem a likely candidate, since it apparently is limited in its operation to organ formation and development, in a locally circumscribed fashion.

If we are correct in theorizing an informational feedback system which "informs" genetic (gonadal) DNA of certain core acquired characteristics, the most likely vehicle for this operation would seem to be the molecular information

system. This is the system involved in immune and autoimmune response, and is not narrowly confined to one functional area or to one tightly constrained system. The general characteristic of the system is the ability to form highly specific proteins or amino acid moieties in response to some biological stimulus, and to carry information so encoded to other parts of the body, usually via the circulation.

If this is indeed implicated in the history of human evolution — particularly of the central nervous system, the brain — this would mean that certain spans of brain experience, and its resulting specific brain proliferative development, would be locally encoded in some molecular information substrate. Then the molecular moiety could be transported in the general circulation, probably the serum protein fraction, to the gonadal DNA. At that step in this hypothetical process, the information thus transported could be transferred. Thus the mystery could be answered as to how the transmission of acquired characteristics (under certain strictly limited circumstances) could be transmitted.

Whether or not this hypothesis hits close to the actual phenomena of nature, the following statements appear unquestionably to be true. The extent to which the internal information systems of the living organism are understood is limited. It is rash to conclude, as though it were a demonstrated truth, that there is no possible way in which characteristics acquired through experience could be transmitted to the gonadal DNA. We have made the argument that human brain must have been forged in the complex matrix of experience, due to its exquisite level of specific structure and function. It seems more reasonable to suspect, strongly, that this has come about through internal feedback than through random mutations which contribute to more successful reproductivity in the competitive stream.

The latter supposes winning the biological lottery every time our ancestors turned around. The former gives at least a probable hypothesis.

The Cultural Genome

Writers not infrequently talk as though, since we walked into the daylight of culture, that we have held onto changes we have made because of their survival value. This is manifestly absurd. For the sake of example, Galileo rejected the Ptolemaic model of the solar system not because it made him reproductively more potent, but because of what he saw through his primitive telescope.

Extrapolate that. It is certainly true that discoveries, once achieved, may contribute to increased likelihood of survival, and of that we could give endless examples. But to claim that the reason, unqualified, that we have pursued discovery and invention is increased reproductivity, is, once again, to venture into the land of Oz and the domain of the Tooth Fairy. That's not the way of it. Aristotle's "all men desire to know" does not carry with it the qualifier "so that they can survive," or "so that they may more successfully reproduce." Knowledge is a primary value; though it may have practical application, it is clearly a good in itself, and one of life's most powerful motivators.

But that gets into the question of where do we go from here? Or, more properly, what happened once biological man, *homo sapiens sapiens,* achieved the level that genuine culture was a possibility? When man became man, a completely different tack was taken in the evolutionary process. Once the plateau was reached where the genetic genome could predictably and efficiently program the

development of the human brain, nature took off in a different direction.

From the first living molecules on up, evolution has built synergistically on evolution. Once the brain was developed to the level where it could support culture, culture became the vehicle for evolution. When olive oil and wheat merchants in the Eastern Mediterranean developed a written system of bills of lading, the written word became the vehicle for evolution's next adventure. Within centuries followed the poems of Homer, the Platonic dialogues, the dramas of Sophocles, and the Metaphysics of Aristotle.

Culture moved beyond the individual organism and became externally objectified in external artifacts, and, more powerfully, in the written works of science, philosophy, and literature. The “genome” of culture arose as the embodiment and language of evolution's next phase. There are remarkable similarities and dissimilarities between the cultural genome and the biological genome. The bio-genome is internal to every individual, and repeated in its entirely in each cell of each individual. The cultural genome is nowhere completely replicated. It is polymorphously diffuse, shared in to some extent by everyone, contributed to by many, frequently at difference with itself internally, and capable of being summarized only to a limited extent. But its inherent capacity for change is even more dynamic than that of the biological genome which was necessary for the development of the human brain, its prerequisite. The cultural genome has developed very much more rapidly that the biological genome.

The cultural genome has gone from stone age to space age in 10,000 years, while it took 3,000,000 years to go from Lucy to Cromagnon. We know clearly what the historical outcome of biological evolution has been — it has been ourselves, with all our warts and disfigurations. We do not

know what the outcome of the cultural genome will be. We are in the midst of its realization, even while we, as far as we know, are the only witnesses to this marvelous process.

Chapter the Fifth

Mind

Our Mind, External Mind

We have come a long way. Our primary understanding of ourselves and our situation was hampered due to the tricky mechanics of Mundus Mendax. As we have seen, nature set us up for misunderstanding both our origins and our functioning. The systematic reason for this is that we seemed to be presented with the human phenomenon in history, pretty much as we were — without an active knowledge either of our origins or of the physiological – and ultimately molecular — underpinnings of our surface functioning. On the basis of what we had, we constructed what seemed to us to be best all-around accounts of how the world really is – our philosophies and religions.

We developed a theory about the world and ourselves which we thought was correct. It took us a long time to do this (long, that is, relative to the limited perspective of human history), from the dawn of pre-history through the high middle ages. Although our best efforts during these centuries failed in their effort to state absolute truth, the level of creative investigation was high, and the human spirit

achieved critical insights, which it might not be well to lose sight of. The walls of the castle we built proved to be too constraining, and we needed to break outside them. But their battlements nonetheless signaled great achievement.

We have not made things any easier. The world, its development, and its structure, tum out to be much more complicated than we ever expected. We may have more in terms of accuracy and completeness, but in a paradoxical sort of way, we have less apparent certainty than we had before. We know a great deal more, but are a lot less certain about fundamentals . During the heyday of Cosmos I, people, even some very smart ones, felt that they knew at least the vast majority of all there was to know. Not just what people did know, but what they could know.

To the extent that uncertainty means that we have a little humility about what we are doing, it is not a bad commodity. If, however, that means that we are mentally adrift in a vast universe with no bearings, and have no convictions about values or what makes the world go 'round, it might appear that we have lost something. The struggle to reestablish an objective equilibrium is an eminently valuable adventure. The anchor stones in a troubled sea have shifted, but the venture is essentially unchanged. The universe is a more wonderful place than we initially conceived it.

The Explosion of Consciousness

The amazing thing about the human phenomenon is not how long it has taken us to get our universe figured out, but, on the contrary, how rapidly the adventure of discovery has been. The hominid line took 3,000,000 years to develop from upright bipeds without language and with scant culture or reflexive understanding to full humanity, sensitive to its

environment and able to communicate with art, paintings and language. Once those strides had been made, and especially once written language had been invented, the human experience has exploded. For many humans, depending on their locus in the stream of events and on their own sensitivity, time may seem to have dragged, and life may have seemed at times to have endured for generations without perceptible change, but that is only an artifact of perspective. Useful and readily available written language developed around 1000 BCE, which is not that long ago. Within a couple of hundred years, the heroic poems of the Greeks and the early books of the Bible were committed to writing. The last 500 years of the first millennium BCE were richly productive. Just about every significant literary form was invented: drama, history, oratory, lyric as well as epic poetry, philosophical speculation, theology, and biography.

After the time of Jesus Christ, most of thought, philosophy, and creative literature in the West was poured into the very extensive project of developing Christian culture, doctrine, and scholarship. Law was codified. The universities were eventually founded, and ultimately the flowering of the High Middle Ages occurred. In the 500 years since Copernicus, Kepler and Galileo scratched their heads and puzzled out truths about the heavens, we have gone from wooden ships less than 100 feet in length to spaceships and space stations.

The most significant change that has occurred during this brief parenthesis in cosmic time is the shifting reenactment of reality that has been occurring between our ears. Not only have we thought a lot differently about the external world. We have also thought a lot differently about the thinker. The process of thought and of knowledge is itself a natural process, and is undergoing vigorous reappraisal. This is not a “done deal.” On the contrary, we are in the very midst of

one of the most actively creative periods we have ever known or experienced.

The Soul in Cosmos I

During the last 5 centuries of the pre-Christian era, there was, particularly among the Greeks, an explosive outpouring of philosophical thinking about the human soul. It is significant, at the beginning, that it was more or less taken for granted that there was nothing odd about the problem of soul. Thinkers from Plato and Aristotle, through the Pythagoreans, the Stoics, the Epicureans, and the Atomists, took it more or less for granted that humans had "souls." The question was not so much whether they had souls, but rather what was the soul's nature, and what ultimately would be its fate. Ideas and teachings about the soul of man ranged all over the possible field of ideas. The atomists, following Democritus and Leucippus, opined that the soul is nothing more than the function arising in chance fashion from atoms cascading through space. Plato, on the other hand, felt that the soul may have antedated the body, and may have come into this current experience with ideas already infused into consciousness. For Aristotle, the soul was the form of the body. The Stoics speculated about the Soul of the Universe.

By the time that Western civilization was "invaded" by the traditions of Christianity, a wide variety of ideas about the soul had already been developed and studied. As Christianity developed an intellectual tradition to support its beliefs and practices, it gradually elaborated a definite theology of the human soul. The human soul came to be seen as a spiritual substance, coming into being at the beginning of each human life, but requiring the direct action of God for its production. This is another byproduct of *Mundus*

Mendax. We did not see how human consciousness could come into existence as the result of natural process.

It was easier, in a sense, to have things packaged in such a neat philosophical formula. According to Aristotelian theory of cause, the nature of an efficient cause needed to be at least equivalent in nature to the effect produced. An Aristotelian system did not provide for the emergence of novelty through internal dynamic process.

The Problem of Mind

We call ourselves homo sapiens sapiens, the wise wise man. Which is an interesting name in itself. But, there is certainly a bottom line connected with this. What sets man apart is his mind, and, taking that as the center of the circle, we expand outward to consider what mind means, and what kinds of problems that raises. We find a peculiar correspondence between the way the mind works and the way the world seems to be in itself. One answer to the problems this raises would be an evolutionary one: “well, of course, it's understandable how mind and reality should have a certain sort of correspondence, since mind evolved in response to the interface between the living organism and the surroundings in which that evolution occurred.”

But, that isn't enough. The mind finds pattern and causality in the outside world. Many important things about our universe have been discovered first in the mind, and then, by experimentation, in the external world when we were convinced that things pretty much had to be a certain way. It turns out that there is a “plan” in the way that external reality holds together. There are many places where, if the world were internally valued any differently, the phenomenal universe we know never could have

evolved. This presents a set of problems that at the same time are both knotty and slippery.

How do we account for this odd, seemingly spiritual, process occurring within this roughly 3+ pounds of brain tissue whirring busily away inside our skulls? How can we understand the ability of this cosmically tiny organ to comprehend the universe? How can we perceive the plan in an external universe? Why, in certain restricted reality spans, does the universe itself seem to dance and jig to the functions of our minds, while it is so intransigently oppositional and resistive in others? How can our brains comprehend their own functioning? What is the meaning and destiny of mind in the universe? Are we oddly alone in a vast and impersonal universe, or in comprehending ourselves in our universe do we unite in superconsciousness with cosmic mind?

If we could answer these quandaries in 25 words or less, that would certainly merit a prize. It is important to know what are the right questions to ask. Some questions may be silly. Although we are not in a position to give the final word on our deepest queries, knowledge itself is evolutionary. The ultimate questions are not silly.

Consciousness: Activation of Brain Tissue

The cells, nuclei, and communicational tracts of the brain activate during awareness.

Loci in the brain “turn on” and “turn off" when we pass from sleep to an awake state. With the development of Electroencephalography, Spect scanning, Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET) we can get more and more localized and

more and more specific pictures of what goes on in the brain when it is activated in certain ways.

We can in some instances utilize these technologies to study departures from normal in disease states. We can compare the differences in brain activation in epilepsies as compared with the normal state. We can localize which parts of the brain are activated during arousal as opposed to quiescence. The appearance of the brain, studied with these procedures, is different during the experience of emotion. We can see the frontal lobes of the brain “light up” during the experience of strong feeling or of focused cognitive attention. We have been able to sharpen our understanding of which parts of the brain activate during somatic sensation as opposed to the functions of motor activity. When certain brain degenerative diseases such as Alzheimer's and Pick's are studied, we can identify the relative quiescence of affected parts of the brain, as well as generalized brain atrophy. Certain brain tumors can be displayed in non-invasive ways when they impinge on other functional brain structures and cause either compression or displacement of brain tissue. The more highly we develop these technics, the more useful they become in a clinical sense.

The utilization of these technics has encouraged our conviction that there is a one to one correspondence between psychological states and measurable brain states. There has been great promise in the development and clinical application of these technologies, and we continue to develop more and more precise and more and more specific procedures for performing these measurements. We have learned much from these areas of research and clinical study.

At the same time, our ability to study brain function lags far beyond what we are convinced must be occurring in the brain during different psychological operations. We know

that the circuit activation which occurs when we think of “two plus two” is different from the activation involved in “why, it's raining outside.” And, there's a different brain activation when we make a judgment that something is true than in the decision that something is false. At our current level of knowledge and measuring capability, we have no doubt that each idea or psychological experience is represented in brain activation in a totally specific and unique way, but we cannot yet measure phenomena at that level of precision on our brain wave machines or computer monitors.

When and how will we be able to identify and model patterns of highly specific brain activation?

History suggests that the answer to that will be “soon” and “thus.” But, we aren't there yet. Let the line of those interested in pulling down a Nobel prize in brain science form on the right. But, at this date, going into the first decade of the new millennium, we have to say that our convictions exceed our capacities to measure them precisely. Stay tuned.

The Soul and the Brain

Functionally, the “soul” of the human is the conscious aspect of brain function. Whether it is “more than that” remains to be seen. But, it is important to work with what we know with a high degree of conviction, and to build on that.

A crucial intelligibility about the existing world is the phenomenon of information. This is an analogous quality of real things. Information in the broadest sense is nature, “the way things are.” This is similar to Plato's “ideas,” or Aristotle 's “substantial forms,” but I don't want to use the

term here with any of the particular philosophical baggage that either of those terms carries. By information, in the sense here used, I mean whatever it is that makes something to be *this* rather than *that* — and let's let it go at that for now.

But, we discover that things can stand for things. Just why, or how, this is true is not a simple problem, but it is inductively true that this is so. Just where this gets first into the symphony of being is problematical, but it is clearly present on the biomolecular level, and is the basis for the effectiveness of the genetic system. The “words” in the DNA chain stand for a particular task that is to be carried out. In the human realm, a language word can be defined to mean just about anything we want it to. I can use “Fido” to mean my favorite pooch. “Automobile” can mean this wonderful piece of machinery I use to drive to work. “The Pythagorean Theorem” can mean relationships in right triangles. Put together strings of words, and you have a complete human language.

Whatever the symbol is, it has two aspects. One is the pattern which is imposed on a material substrate. The other, that which the pattern signifies. In our consciousness, the substrate is that complex brain activation which is somehow a pattern for any aspect of conscious experience we may have. The other side of the phenomenon is that which the pattern signifies, which can be as simple or complex as we wish to make it. In a living entity, ourselves, the pattern and the thing signified are one and the same, but that single phenomenon has two aspects: the pattern in the brain, and what that pattern signifies. However, the specific characteristic of dynamic brain patterning is that it is conscious. We are aware of it. It is a part of our consciousness.

There may be other things that are true about it, but one thing that we can say, for our purposes here, is that the "soul" of man is that flowing stream of brain patterns that occur while we are alive, and those things, those aspects of a total reality that are signified by those patterns. Note: this does not make of the soul a material thing. It says nothing about philosophical questions like whether the soul can outlast the body. This is a functional, and not necessarily an exhaustive definition.

Symbolization

The power to create and use symbols is the ladder by which we have scaled the ramparts of a sometimes-adamantine universe. Not only do we sense things and name them, we also are aware of our awareness. It is difficult to conceptualize what kind of constraints that puts on the patterns of brain activation that support the experience.

We do not have any way of directly measuring or metering this level of cognitive complexity and subtlety. At this point in time, the only way we can approach understanding is to dissect the experience intellectually. (That too has to be somehow supported by brain function.) There are very strong reasons for theorizing that everything in our experience has brain activation as its biological substrate.

There are two "sides" of the coinage of cognition. On the side of the physical brain, there is the complex activation of the brain network. On the cognition side, it is necessary to consider several different aspects, or phases, of the complex psychological experience.

1. The direct sensory datum (as, for instance, the perceived picture of Fido).

2. The name that I give the percept.
3. The “meaning” that I attach to the percept (the significance of the concept “dog”).
4. The reality value I assign to the experience (This *is* a dog).

We do not experience our cognition as comprised of different “parts.” It is only when we study the phenomenon that we can tease apart the complexity. All reality possesses specification. Things are what they are, and the differences that that entails makes up the world that we know. In living things, systems of symbolization become much more freed from the primary quality of things as they exist in a material way. A dog is “aware” of the intruder into the house. That awareness is one “side” of the activation which is enacted in the dog's brain.

In human consciousness, awareness achieves other dimensions than dogs are capable of. Dogs do not puzzle over the reality of things — as far as we know. But, whether they do or don't, it is clear that we do, and that's the emphasis here. We know what we mean when we ask about something, “yes — but is it real?” We want to know what it is that we're talking about, but we also want to know whether something is “only an idea,” or whether it has reality in the world of existing things. Existence is an important aspect of anything.

We attach names to things. And that seems to be a particularly human operation. Our ability to symbolize aspects of reality is flexible and extensive. It is questionable the extent to which other animals are capable of doing this. It seems clear that to some extent they can. We have been puzzling over this peculiar aspect of thought and consciousness since we started worrying about things in themselves. Plato felt constrained to hypothesize a world of

independently existing “forms” or “ideas (ideals).” Aristotle identified four types of “cause”: formal, final, material, and efficient.

Ideas such as these helped us to generalize about our experience and our world, and in that sense they served a purpose culturally. Problem is, they came to function as intellectual flypaper, and we tended to get stuck in them. We had a hard time moving beyond them. The important realization is that we can symbolize, and that reality is in fact pervaded by symbolization and information carrying. In the complex phenomenon of our thought and consciousness, we are aware of “things,” but we are also aware of our own consciousness. It is a peculiar aspect of our brain function that we can be reflexively aware of that consciousness itself. It is that reflex awareness that creates the “problem” of mind.

How it is that that we can symbolize symbolization is more than a little mysterious, but it is clear that that is an intrinsic aspect of the way we work, and the way our brains work. Some activation of brain network is necessary for human consciousness. This necessitates a specific pattern of brain activation when we are reflexively aware. It is difficult to know just what that is “like,” but we need to identify it if we are to be consistent.

Extension, Existence

The brain states of man and the awareness states which are the conscious dimension of those brain states are sequential. And, whatever else is true (and that may be considerable), it seems consistent with our experience and with a developing theory to say that that sequence of conscious brain states is what we refer to when we speak of

mind. We can gather and organize the “facts” that we glean from both raw experience, and from the more specialized experience of science. That has been one dimension of the discoveries of Cosmos II.

There are two specific aspects of reality which in particular present themselves, and need to be dealt with in particular ways. Reality presents itself as extended and quantifiable. This gives rise to measurement and the more abstract aspect of measurable things, their mathematical representation. Mathematics becomes an independent way of looking at reality, or theorizing about it. And, one of the wonders of the existing universe is the marvelous interplay between our mathematical constructs and the way external reality exists. There are many things we have discovered about the external world because they “had to be that way,” mathematically speaking, and then we went to the outside world and found that that's the way reality really is. The other, all pervasive, aspect of reality is reality itself, or the existence of things. We need to know what we mean by reality, and to be able to talk about it in a consistent and meaningful way. And, this is difficult, in particular because it is a way of thinking which is different from the mindset of science. And, of course, we are enamored of science because of what it has shown us about ourselves and the world we live in.

Talking and thinking about what we mean by reality and existence is metaphysics. Too bad we have to use that word, since it carries so much cultural baggage, but, it is counterproductive to make up a whole new vocabulary every time we tum a comer in the countryside of thought. It is better to use the words that our culture has given us, but to make sure that we stay on a clear track, and not to fall into morasses with which the history of thought presents us.

But – where we are headed is towards understanding God and Atom, and, if we are going to get that straight, it is necessary to work with a clear and consistent metaphysics; otherwise it's hopeless. This is tricky, but not impossible. It is not only possible, but necessary, if we are going to come out on the other side with a complete understanding of ourselves and the cosmic process of pursuing truth.

The Cultural Genome Once More

Once evolutionary process developed the brain with its symbolic capacities, the process of evolution continued, but on a different plane. Significant evolution has been not in the structure and physiology of the brain, but rather in the brain's product: the thought and discoveries enabled by the brain. We have been pursuing an understanding of that process and its content, and there are many things which need to be said in the complex effort of understanding a highly complex phenomenology. The content of the phenomenology has to be understood, but also it is necessary to account for the process itself.

There is no identifiable single locus for the cultural genome. It is an active, living thing, though not in itself. There is an ongoing communicational matrix between the mind, the external universe, and the way in which we give a quasi-substantive reality to our thoughts in the representations we create and record in some external fashion. The ideas, plans, and explanations we create are part of the cultural genome. The formulas we manufacture mathematically are part of the cultural genome. The explanations we formulate of relativity and of the controlling physical constants in the cosmos are themselves part of the cultural genome. When we give an account of the

history of thought itself, that too becomes a part of the cultural genome.

The evolution of the cultural genome exploded, as we have seen, once we invented writing as a tool for giving a certain objectivity and permanency to the project. It is impossible to comprehend the genome exhaustively, and yet it is in understanding it that we understand the universe. Understanding the universe is an aspect of it.

There is a complex action-reaction process that occurs between our minds and the external representations of our minds that we attempt to create. There is a complex action - reaction process that occurs between our minds and the evidence presented by the external world. We have worried at this process since we walked out of the trees, and we will continue to worry at it for the foreseeable future.

A paradox about the development of understanding, and therefore the cultural genome, is that what is "out there" is bigger than what occurs in the brains of any of us, yet the activation of the genome occurs only in the brains of individuals. The external representation of the genome is not in itself conscious. Discovery and understanding are both individual and social. This is why we have conferences, give lectures, write books and continue to ponder and communicate. This is why, in current time, the Science – Religion project has developed a new vitality and vigor in our thoughts and communications.

A Planned Universe

Sir Martin Rees has described "the deep forces that shape the universe" in his wonderful and frighteningly short book *Just Six Numbers*.

These values are: n, epsilon, omega, lambda, q, and d.

- “n” is the strength of the electrical forces that hold atoms together, divided by the force of gravity between them.
- “epsilon” is the nuclear efficiency and is related to the strong nuclear force. Its value is 0.007.
- “omega” is the ratio of the actual density of the universe to the critical density of the universe. It has to have a value only 1 in 10 /\ 15 different from 1, otherwise we could not be here.
- “lambda” is the strength of cosmic antigravity, Einstein's cosmological constant, and is fortunately very small, but not zero.
- “q” is the ratio of two fundamental energies, and has a value of 1/100,000.
- “d” is the number of spatial dimensions in our world, and as you would expect, its value is 3.

If I were to explain how all these work (assuming I could do a better job than Rees, which is absurd!), it would take all the fun out of reading *Just Six Numbers,* so I won't. You are hereby appropriately referred to the source.

To say the very least, the “six numbers” are shorthand for a very large amount of theory and experimentation that has occurred. These are not conclusions brushed off the top of someone's thought on a sunny day in spring. Nor do they impel one to exclaim, “Aha! Just as I suspected. I knew it all along.”

The point I do wish to make here is that, as thinkers have probed deeper and deeper into a universe that sometimes seems random and chaotic, what turns out is that this vast enterprise is in fact very finely tuned at critical places. There are many places where if the universe's “deep forces” weren't “just so,” the universe wouldn't hold together, and we wouldn't be here.

Complex Plan in the Mind

The universe is not a simple place. Understanding it is not a simple project. Sometimes we get a bit exhausted when we even think about it. But then, in opposition to that, there are times when we marvel at the glory of it, and are excited and exhilarated, so that we wish to throw ourselves into the adventure of pushing further.

The universe manifests a complex and highly varied plan. A plan here means what Rees is talking about when whispering just a few little numbers in the ears of our souls. But it is also the way that relativity works, the way that Schroedinger's understanding of quantum mechanics works, the way that molecular biology and DNA work, the way neurons fire, and the way that everything we know about is symbolically "reenacted" in our brains.

"Plan" also means Darwin's insight into natural selection and the ways in which we need to enlarge on that core idea. It also means the pattern of approaches over the centuries that the mind and spirit of man have elaborated. It means not just the patterns we stumble into in our hike around the universe, but the patterns we have created in attempting to deal with plans within and without. It means, therefore, the pattern of creating Cosmos I and then turning our back on it and proceeding to modify it through the development of Cosmos II. "Plan" therefore means the process of an evolving intellect gradually coming to comprehend not only the universe, but the complex process of its own evolution.

Our knowledge is symbolized in the activation of our neural networks by words and images. In this sense, then, the plan in our minds comes more and more to resemble, and contain, and be in some sense identical with the complex plan in the universe.

The objective would then seem to be having the complex plan in our minds — in our brains — symbolize more and more adequately the plan we discover in the external world, which includes our own history, and the universe's total evolution.

In our minds, surely, but also in the objectification we create in understanding, modifying and contributing to the cultural genome. This is selfish, in one way, but shouldn't be. Contributing to the cultural genome is subjectively an enriching experience, but it is also giving back to the universe which generated us, and to other minds in the matrix of consciousness a very valuable surprise. It is pulling the tinsel and tissue off the prize of the universe itself and sharing it with each other. It is Christmas all the time! It is also our racial future.

Uncertain: Outward Bound Mind

The expansion of consciousness on the planet has been one of the most highly explosive phenomena in an evolving universe. We have generalized the development of culture under the headings of Cosmos I and Cosmos II. At the very beginning, we noted the Procrustean nature of this venture, and mused over the personality quirks of that Eleusinian highwayman of long ago. Eve wondered what it would be like to eat of the fruit of the tree of the Know ledge of Good and Evil. Pandora, the “all-gifted,” turned her magical box over and over in her pretty hands hundreds of times before yielding to that fateful pressure of building curiosity. Aristotle opined on the universal thirst for knowledge. The only way to understand things is to squeeze reality into compartments where they don't really fit well — yet if on the whole we “get it right,” we can then push ahead with a

little more enlightenment, a little more appreciation of our place in the universe's complicated matrix.

Stars when they reach a certain stage in their life histories, go supernova and explode. That is a rapid change. We can see those phenomena when they occur in the distant skies. The explosion which occurred at the time of the Big Bang was fast. Cosmologists theorize in microseconds, indeed nanoseconds, about spatial expansion, matter-energy conversions, and the formation of the initial atoms which then became the building blocks of the visible universe we know in experience. Phenomena on those levels accomplish things in very brief time. If we watch in our mind's eye processes like the formation of continents on our planet or the development of the early forms of life on the planet, the pace of change is a great deal more leisurely. Even, as we have done, if we watch the separation of the humanoid line from the pongids, and, later, the gradual evolution of the human brain, comparatively long periods of time — millions of years — are involved.

If we conceptualize consciousness as a light controlled by a psycho-rheostat, and draw off a respectable distance from our planet to watch the show (we need to plan for ourselves a life span of thousands of years), it becomes thunderingly clear that the upsweep in consciousness illumination is a natural phenomenon of unusual speed. Far more rapid than the formation of mountains or the evolution of species. Relatively speaking, explosive!

The Future Project

Where does the line of the future development of consciousness point? If we extrapolate the curve of

expanding consciousness to date, where does it go? And how do we guide the process?

The fragility of the experiment needs to be emphasized. There is no guarantee that the psycho-rheostat will continue to intensify at all. Our species is delicately balanced within a narrow spectrum of life support. Any one of a number of either slow or sudden catastrophes could occur to bring this interesting experiment to a sudden and calamitous halt. Another asteroid like the one that hypothetically polished off the dinosaurs could swing into earth's gravity and be drawn inexorably into collision course, with disastrous results. We don't know if we could head that off during the time we would have to take some form of evasive action or interaction, and there are all sorts of knotty problems with the engineering that would be involved in a successful intervention.

If external nature allows us to continue on the planet, we have within our own capacities the power to bring about our own destruction. Positively, we could in one way or another destroy ourselves in a conflagration of global warfare. The spectre of auto-destruction is not altogether impossible. Negatively, we could bring about a state in which the world we so dearly love might become inhabitable. Through exhaustion of the world's resources or increasingly devastating pollution, we could make our planet increasingly less capable of sustaining higher life forms, forcing evolution to tum its vector downwards into a twilight of gradual extinction. Those are not happy possible outcomes to this rich and marvelous experiment we have been engaged in on spaceship Earth. To the extent we are in control, we apparently have time to assure a positive outcome. But, on the bright side, what further light could the advancing psycho-rheostat shed for us?

In Cosmos I, we saw the human psyche as imposed suddenly on our universe by omnipotent creative power: Adam in Eden in Genesis or on the ceiling of the Sistine, as per Michelangelo.

In Cosmos II, it would be an unwarranted conclusion that the universe is material, and that the aspiration of spirit, or the reality of spirit, is illusory. That's not the way to read the available data. Rather, what seems clear is the conclusion that the world is much more dynamic and interrelated than the writers of Genesis or the philosophers and theologians ever realized.

Spirit – consciousness – intentionality – transcendence is very real, and may well be the most basic of the universe's realities. The world is planned-structured with determinate value such as referenced in *Just Six Numbers* or Stephen Hawking's *Brief History of Time.* The conclusion of science and mathematics may well be not the unreality of spirit, but rather that spirit is profoundly involved with the internal nature of matter, and, as far as phenomenal spirit is concerned, evolutionary from matter. That's what we need to understand more about, and that's what we'll be working on.

Working as a mathematician, Hawking speaks in various places about the need for a creator, or about where could the mind possibly go beyond the powerful insights of theoretical cosmology. Hawking isn't inclined to go beyond his science, which speaks well of his modesty of character. All to the good. God, in Hawking's thinking, is a logical placeholder more than an existing reality. The trick, at that point in the conversation, is in understanding a conclusive metaphysics. The question is what does the universe, as we know it to be, metaphysically entail?

At that point, not God as logical placeholder, but as metaphysical entailment. And spirit, not as reducible to

matter, but as evolutionary from matter, in the strange phenomenology of ourselves — and of any other similarly intelligent beings should they have evolved anywhere else in this widely flung universe. But, not clearly limited by, or restricted to, matter.

Chapter the Sixth

God and Atom

Tapestry

One short book is an inadequate space in which to recount the history of the human race - or even, for that matter, of human thought. On the other hand, it is possible within that scope to give an account of where the major elements are, and how the overall fabric holds together. It is possible to describe the outline of the metasystem, and that is what we have set our mind to here. The world came into being at the Big Bang. The Earth formed from matter in the circumsolar disk. Life started to emerge about 4,000,000,000 years ago. Mammals have reigned for the last 60,000,000 years. Hominids separated from the pongids 7,000,000 years ago. Australopithecus walked 3,000,000 ago. Homo sapiens came 100,000 years ago+/-. Modern man can be traced back 30,000 years ago +/-. Cave paintings 25,000 years ago. Advanced culture 5,000 years ago. Usable writing 3,000 years ago. Up to 1500 CE: Cosmos I. 1500 CE to present: Cosmos II.

This story is our family history. The task becomes at this point to weave what seems to be a tangle of strings together, so that they become a consistent fabric. There is a universe

to understand. There is more to learn, and we need to get on with the job. Cosmos I saw the world as created by God, and man as struggling with the adventure of his moral and historical relationship with that God. Cosmos II sees the world as evolutionary from the singularity of the Big Bang, with nature's colorful symphony emanating therefrom. At first glance, Cosmos I seems incompatible with Cosmos II. It is not. There are new ways of looking at things, but we and our ancestors work with the same mind; it is the perspective and the accumulated growth of experience which differentiates our views.

As we verge into the Third Millennium CE, there flourishes a new movement, the Science and Religion project. This builds on many different programs which saw their dawn during the last half of the 20th Century: Zygon (Chicago), Metanexus (Philadelphia) and Counterbalance (Seattle) are examples. Since 2002, the American Association for the Advancement of Science (AAAS) has sheltered a division devoted to the project. It is not incidental that this broad movement emerges at this time. We are ready for it. There are new insights to be developed, new horizons to be limned.

The objective of the Science-Religion project is to draw relationships between these two areas, and, hopefully, to wed them. Some see this as a hopeless venture. As strong a contributor as Jay Gould, unhappily recently deceased, felt that religion and science represent two *magisteria,* or spans of teaching authority. Gould thought that there are non-overlapping areas of study or belief which need to hold sway on their own territories. This, of course, is not very satisfactory, for it either means that there are two irreconcilable ways of knowing the universe, or there is (perhaps) one way of *really* knowing the world, and one set

of emotional activities which faintly emulates the process (which in its turn also isn't very satisfactory).

And it thunderously misses the point. If the science-religion venture is possible and necessary, then they have something substantive to learn from each other, and neither is nor could be complete in itself.

Wonderment

We have not solved the ultimate reaches of the mind-matter problem. Or the science - religion problem. Or the soul-body problem. Or the God-man problem. Or, to tell you the truth, any of the basic problems man has about himself and his universe. Or man *in* his universe. In spite of all the progress we have made, there is assuredly room for uncertainty and doubt about not only detail, but about major perspectives on the structure of the project of discovery itself.

We certainly aren't at square one — but we are still a long way away from the square marked “Home.” We do not know what “home” would be. We are in the midst of the process of evolution, and the frustrating thing about being in the middle of a process is that the terminus of the process is not visible. We are learning to understand the mechanics of the system, but we do not really know where it is headed. It won't do to say that there are just some things which cannot be understood. The postulate we are working with, grantedly, is that reality is comprehensible. With a clear corollary: that we don't give up on understanding things, no matter how thorny or slippery they might seem to be!

Coming full circle, we said at the beginning of our journey, “The road to understanding is rocky.” Well, it is. Along the way, we have stoned heretics, burned non-

conformists at the stake, driven people into exile, driven others mad, ruined careers, set nation against nation in devastating warfare, and just caused a lot of personal and civic ruckus. This has been anything but an easy journey. But — and there always seems to be a “but” — it has been an exciting adventure, and, we have moments and areas of great success. Even though the rockiness has been there, so has the satisfaction, the vision and the glory. The trip from Cromagnon's first appearance 50,000 years ago has actually been a short one. By cosmic time, this short time segment has gone by in a flash.

We framed our story as a “Tale of Two Cosmoi.” First, the building of the Medieval mindset, with its ultimate shortcomings. And, the adventure of empiricism, with its immense successes, and the way it turned Cosmos I on its ear. We spoke of the rat gnawing at the root of Cosmos I's tree — and found it to be a growing dissonance with observational data. And the energy of that dissonance fueled the engines of discovery, propelling forward the project of empirical inquiry, bringing us to our current position of Cosmos II. But, aha! have we solved the problem? No, we have not! Tums out our rat has brothers. There's something wrong with our current picture, too.

There is a mysticism in focused scientific attention. It is possible to get totally absorbed in the intensity of scientific concentration. The adventure of discovery is exciting and entrancing at the same time. The system itself has a certain narcotizing effect. We enjoy the kind of empirical conviction that comes along with successful mathematical equations, and with peering through our lenses at the animalculae which swim around on the slide before us. Scientific observation needs to be painstaking and attentive. But, when it works, it brings with itself a particular satisfaction. This satisfaction at grappling with the mind's

interface with nature is the fuel that drives the engine of investigation.

But — the rat! What gnaws at the root of observational science is curiosity at the underlying structure of thought itself and the skeletal cogency of mental process. We wonder at why and how the universe is here, and where our minds and spirits fit into the scheme of things. That's partially an empirical problem, but it is metaphysical, and, at times, religious as well. And, we instinctively feel that we have come far enough down the road of history to share perspectives, and to use insights from apparently irreconcilable disciplines to envision new horizons. Scientists too are part of the cultural stream. Although their activities *qua* scientist separate them to an extent from metaphysical concerns, they have instinctive itchings that there are implications of their presuppositions which are deeper than empirical. There's our brother rat! Observation has its limitations, and we want to peer beyond into that depth of existential intelligibility.

Universe: Delicately Tuned – Evolution

The Universe manifests itself as planned in its deepest structure. Matter is not formless blob. Here, it is important to separate “plan” from its intentional connotation. Although that has metaphysical import, too, and this is a topic back to which we will need to return.

One thing we have inherited from our empirical tradition is a strong reaction against the concept of an anthropomorphic God. The concept of a wise old man sitting on a throne among the clouds and judging human efforts does not fit will with the rest of our mental machinery. On the one hand, the idea seems to be a projection of our own

consciousness into an external world. Part of us would like there to be something like us out there controlling things. On the other, if there were a mind like ours ordering the universe, we don't like that thought, either, mostly because if there were, we would have a store of anger against him for the amount of evil, suffering and frustration he would have planned into his universe. So we reject the thought of an anthropomorphic source of existence.

But, however that comes down in the end, we need to be constrained by the evidence of fact. The problem of plan and basic structure in the universe continues to pester us, and that's a place where we need to work. Although causal relationships are stock in trade for the investigator and the theorist, and we would like everything to be connected with everything in a mutually explanatory way, the world represents itself to be shot through, from top to bottom, with specific quantity and value that seems to be just the way it is, for no apparent reason. For no reason, that is, that we can readily identify. Where does the defined character of our universe come from?

The macro universe manifests cosmic constants, from the force of gravity to the number of atoms in the universe, to the number of spatial dimensions. There's a lot that's the way it is before we ever get down to things on our home planet. We treasure the discoveries of Galileo and Newton — but the marvel of it is that they discovered things which were there before anyone thought of them. We have concluded, strongly, that we have evolved, and that somebody didn't just think of us the way we are in a global fashion. But, oddly, the many mechanisms which contributed to our evolution seem to be highly arbitrary yet externally subsistent — and that puzzles us. We cannot understand – exhaustively, at least – how the qualities which the atoms manifest emerge from the numbers of neutrons and protons

in the nuclei and their ambient electrons, nor how, in the other direction, all the qualities of molecules derive from their atoms. And so on. But, the conclusion is this: although the question of macro-plan in the universe is immensely problematic, it does seem that the universe top to bottom is highly determinate in its characteristics and values. We understand that it is that way, and that is the raw material of our learning. We do not know, in most instances, *how* it is. And – as our knowledge of the mechanisms of evolution increases, we see, more and more, that the sum fact of evolution depends on the nested matrices of systems that are "just so," without which our evolution could not have happened. We exist in the midst of, but yet downstream from, a complex universe. And, we do not have, for many stretches of the phenomenology, the foggiest idea how things basically got to be the way they are. Somehow the symphony of evolution in all its richness and variety is contained is the singularity which generated the Big Bang. And that is truly a puzzle for the mind!

Limits of Knowing – Matter and Spirit

We are closing in on an understanding of the empirical aspect of mind. There are two major dimensions of this.

The first of these is the way that consciousness is represented by the activation of networks in the brain in real time. As a result of the neurological investigations of the twentieth century, we have a significant appreciation of the structure and function of the cell, that basic organizational structure of living tissue. We know that each neural cell in its macrostructure connects with thousands of other cells, and that its basic macrofunction consists of "firing," or the origin and propagation of neural activation. We know that

coordinated firing of cells together is the chief macrofunction of the brain. We also know that, internally, each cell is its own immensely complicated biochemical factory, with specific molecular and ultimately atomic structures and events which support and constitute the cell's operations.

Using gross figures to give us a sense of overview, we know that our brains are roughly 1400 cc in size, and that they contain roughly 14,000,000,000 cells, which happens to be convenient for calculation. That means, then on rough averages, each cc of our brains contains about 10,000,000 of these wonderful cells, which is certainly enough to create staggering levels of communicational complexity. We know that cells are not just dumped unceremoniously into our brain boxes, but that they are differentiated greatly in terms of their specific structure and function, and that their organization into nuclei and the tracts that connect them is itself immensely specific and complicated.

But, putting all of that vast complexity together, we know that the material side of our consciousness consists of the activation of these incredibly complex networks in real time. Materially, mind and spirit are sequential brain activation. But that of course doesn't answer the problems of mind and spirit. That just locates it the observable universe, and describes the character of the underlying material substrate of consciousness.

The second empirical aspect of mind is the manner in which information is symbolized. This is trickier, even, than describing brain function. And, it is easier to describe the "that" of the situation than the ultimate "how." But, there are important things to say. Meaning can be imposed by consciousness on any pattern that consciousness might choose. This is at the root of language, and, among other things, explains why there is more than one human language.

We saw, early on in our investigation that it was the invention of written language which supported the development of the cultural genome, which, as we have seen, has been the actual vehicle for the continued evolution of the human race, rather than modification of the biological genome (DNA), which has been pretty much constant, overall, since our species started to walk around on our planet. And, incidentally, as also we have seen, has remained pretty constant, percentage wise, between ourselves and our chimp cousins.

The specificity of our abstracting mode of awareness is closely related with our ability to name, and to form abstract concepts, such as the concepts of mathematics and the concepts of the sciences and, for that matter, the concepts of law and social interaction. The concept of human rights doesn't have anything to do with any particular area of life. It is analogously applicable over widely divergent areas of living: property, contracts, citizen status, and government.

We, without thinking about it, impose profound depths of meaning on patterns of brain activation. But, although much of the time we don't *have* to think about it, we *can* think about it, as we are doing here. A brain activation pattern can represent something very material, such as a book (or anything else), but the word “book” which we assign to signify the thing, can be associated with the same brain activation. And, *mirabile dictu,* the same brain activation can also have a reflex quality to it, so that I, as a person, am aware of the fact that I am having this experience with its different aspects of complexity.

This complex symbolization “in” the phenomenon of brain activation can and does escape the particularity of matter and of any particular experience. Matter is extended and located. Signification, as it occurs in our consciousness, doesn't have to refer to any particular material reference,

although it is always possible to refer it back to the elements of its origin in material experience.

But, at that point, our minds can deal with existence in itself. In so doing, the mind "escapes" the particularity of matter. An aspect of our consciousness can concern itself with anything which either does or could exist anywhere, and in any possible realm of reality. And that is where human spirit generates and functions. We find, in the operations of our minds at this level, something which seems to us to be very similar to what must have gone into the very structure and coming into being of the universe itself. And that drives us to wonder about the ultimate possibilities of consciousness and mind, and, in fact, of the ultimate reality and existence of anything at all, real or possible.

Organicity of Thought

The development of the cultural genome is the vehicle for significant evolution. A major problem has been that advances are both liberating but constraining. If we learn a new way of looking at the world or at some range of phenomena, we tend to try to apply that technology to reality itself and to the entire universe. If we develop the technology to study and comprehend a dimension of reality, there is a strong tendency to apply that technology to all other ranges of the existing universe. And, that can be a snare to the progress of knowledge.

Science, in general, works! Beyond wildest dreams. So, it has been a natural tendency to think either that empirical observation can answer everything, or, the converse of that errant position, that scientific answers are the only answers. At the dawn of time — that is to say, at the dawn of history — man walked onto the stage of experience fully formed and

already evolved, and did his level best to try to understand himself and the world in which he found himself. He dreamed and schemed, and constructed theories of experience and reality. When our ancestors started writing things down, they advanced the formation and propagation of our cultural genome. It is natural enough that they worked with what was available to them — what they found in their experience.

Not only, as we have seen, did they not recall the actuality of their origins, except in the most mystical and mythological way. Also, they had very shallow understanding of the natural infrastructure of their function and, in particular, their thought. The development of the cultural genome needs to be seen as a biological and organic phenomenon. It is not that the philosophers of old were wrong about things; much more it is that they were discoverers en route. It was natural enough that philosophical and religious attempts to understand the world predated successful empiricism, which required two things, especially: 1) the establishment of an intellectual beachhead, first of all, and 2) the development of instrumentation, to extend the range of sensory perception which nature had provided.

Orthodoxy and Doubt

During the centuries of Cosmos I — the Ages of Faith — we invested heavily in Orthodoxy — the belief generally that there was a privileged avenue to truth, that God had revealed great Truths about the universe, and that salvation was intertwined with the acceptance of those truths. Not the least of human achievements during the centuries of Cosmos I was that humans defined for themselves, intellectually, a

place for themselves in the universe. Although changes in perspective made it necessary for thinkers to move ahead to new positions, that would not have been possible without the work that had gone before. Humans thought they lived in a geocentric universe. That was factually incorrect, but that's not the important point. The important point is that humans convinced they were *somewhere,* and from that point thinkers could move ahead to establish the next cultural redoubt.

We needed to discover new things about our universe, but prior to that, we had already established great splendors of art, literature and architecture. It was from the great richness of the Renaissance that Galileo marched into the future mathematically and observationally, through his weak telescopes, but he could not have made that step in the journey unless he was already convinced of the greatness of the universe. The thinkers of the early modem age needed to reframe questions, and develop new approaches. The thinkers of Cosmos I left their children with contradictions between their philosophies and the available observations.

Cosmos I dealt with the moral condition of man and the source of plan and design in the universe. We needed to move away from the limits imposed by those horizons. And, in so doing, we have extended our understanding into the world of the atom and the world of the galaxies. We have discovered the underpinnings of our biological structure and function. We have gone quite far down the road of filling in the factual basis that the philosophers and theologians lacked. The next shifting of intellectual gears that we need to accomplish is to discover and shed light on the relationships between science and religion. We are in a position to close the gap between God and Atom.

Metaphysics

Metaphysics is inescapable. We cannot work without some theory of existence, either explicit or implied. The reason for this is very simple: the most basic possible aspect of anything is its existence. We all know what it means to exist, to be real. But that doesn't mean that it is easy to think or talk about existence in a knowledgeable way. Truth of the matter is, that is a very slippery slope. It is a real intellectual challenge to develop a useful and adequate theoretical exposition of what we know about existence, and what are the ramifications of that knowledge. There are many difficulties developing a decent metaphysics, but among them, two are outstanding. The first is that it will be quite different from other branches of "science." And the second is very closely allied to this: it will not be capable of being verified or tested by anything external to itself, and that really tends to bother us.

Metaphysics is a field unto itself. It has to be. It is like the canvas on which a painting is created. To use an analogy, let us say that the universe of other knowledge is like an extendable plane, full of facts, data, formulas and all other possible categories of things that we sense, know or feel. This plane contains all our sciences, experiences and fields of knowledge, records of all possible sorts, and is infinitely expansive and unlimited as to what it can contain, or what can be developed. If we imagine such a plane in our minds, then metaphysics is a knowledge that runs perpendicular to that plane, true everywhere in an analogous fashion, distinct from any particular knowledge, yet applicable to all particular knowledges.

Metaphysics is a knowledge that is true about everything which is real, and gives insight into what we mean by reality in the first place. Clearly, this perpendicular dimension

through the plane is not like anything on the plane. Although everything on the plane is enlightened by it, it needs to be quite different from any particular phenomenology or knowledge of particulars. The "science" of metaphysics cannot be "like" any other science. A close corollary to this uniqueness of metaphysics is that it cannot have any yardstick of method of verification outside of its own internal luminescence. It will not be possible to tum somewhere else to see if its theories or statements are true. And, of course, that tends to bother us, because in other areas of knowledge we like to tum to collateral phenomenologies to verify a statement or theory.

But, if we think about it, that aspect is not so unreasonable or unusual, either. The basic insights of mathematics, for instance, have a similar independence, too. We cannot "prove" the Pythagorean theory, at the end of things, by anything that is more probative or enlightening than the essence of its own intelligibility. In an analogous fashion, the "test" and "proof" of metaphysical theory and speculation needs to be in the primary lucidity of its own statements.

Metaphysics — Why?

The purpose of doing metaphysics is the need to verge towards a complete understanding of the universe. And, on a less cosmic scale, the need to understand the here and now, the immediacy of our experience. Although metaphysics has an importance, and a very large importance at that, it also has its very definite limitations. Returning to our analogy of the plane filled with facts, and metaphysics being a vertical penetration through that plane, a major limitation is that while metaphysics may describe what the plane is like, it

really won't tell us much of anything about what we can find on the plane. Understanding may be critical for seeing the universe whole; it won't, however, tell us what in a detailed way we may expect to find within that universe.

The primary significance of metaphysics is to be found in itself. Metaphysical insights are important because they put into rational terms our basic understanding of the universe. Metaphysics is not a practical science, in the sense that we can use it to get practical work done. That doesn't mean at all that in the grand scope of things it will inevitably and forever be without direct application. There are aspects to this universe which are still quite obscure to us. We continue to make inroads into those dark countries. The odd thing about our world is that the things which overall might interest us most are also the hardest to lay a hand upon. We wonder what the ultimate nature and destiny of mind in the universe may be. We wonder whether the idea of God in a visible universe is an imaginary wish, or fear; or whether, on the other side, it may be the most real of ultimate realities. And, however the truth of that may come down, we wonder what possible or real difference God may have for mankind and our future history.

Questions like the ultimate nature of mind and the reality of God are questions the answers to which can make possible sense only in the context of metaphysical study. The primary object of metaphysics, in the order of discovery, is the immediate reality of our experience. We cannot jump immediately to more interesting questions such has ultimate signification and ultimate reality, yet, at the same time, to the extent that rational speculation about such issues is even a possibility, such questions can make sense only in a metaphysical context. They are not empirical questions like how many planets there are or the age of the physical universe.

And, there it is that in the long run, metaphysics may have quite practical applications, indeed. Where we go as a race, as a biological experiment on planet Earth, may in fact depend on such apparently impractical problems as the nature of mind and the existence of God. Those matters are worthwhile thinking about, but their application or solution is more a matter of our future history than of our capacities for performance or discovery here and now.

Existence

Our minds know things in terms of content and fact. The basic questions of reality are 1) what is it? and 2) is it real? We can imagine a griffin, a denizen of a medieval bestiary. We can have a pretty clear idea of what it is that we are thinking about. But, when we ask ourselves, or enter into a conversation with someone else, whether a griffin is real, we say, “no – only in the imagination, or in fairy tales.” It's quite different question to ask whether a Tyrannosaurus is real. We know what the question means. And, we answer, “well, not real today, but it used to be real.” What we mean in these queries and their answers is whether or not something exists, or existed, and, possibly, in what sense does it exist.

The universe presents itself to us as real. Difficult to know accurately, but real, nonetheless. If we propose a certain model of how things are, in a particular area, we know what we mean when we ask, “yes, but is that the way the world really is?” We know what it means for something to be true. Yet, when we tum to the task of making explicit what that truth means, we find that that task becomes a lot more slippery than we thought it was going to be.

“Existence” and “truth” are metaphysical. Which does not mean at all “New Age” or “poetical” or “fuzzy 'round the edges,” which might be possible meanings of metaphysical in some other context. Metaphysical here means “pertaining to reality” or “about existence.” Metaphysics means pertaining to the most fundamental aspect of anything, its reality. To reference a sad historical incident, metaphysics depends on what the meaning of “is” is. The reality is that when those words were spoken, we all knew instinctively what they meant. But, it's the intelligibility of that on which we focus here. What is the “is” in that, or similar, sentences?

“Is” is not a something, it is a whether. The intelligibility we need to tease out of the reality matrix is what we are saying when we say something exists. Existing is something dynamic and active. It is, in fact, the most basic aspect of anything by which it is real. In developing an answer to this, we cannot give an answer by genus and species. It is not like saying that an Irish Setter is a dog with a reddish coat. We are not defining anything when we talk about existence. We are pointing to something and naming it. We are pointing to something and explaining it, or identifying it. The epistemological problem is that the insight we want to get at is completely simple, and not capable of being explained by reference to anything else.

We can use words to point and to limit attention, but we cannot find anything that is simpler. In that context, what we mean by existence is the fundamental *act* by which something is real. If something exists, it is “doing something.” Not other than existing, but existing itself is something that can be understood and referenced in itself. And, what the meaning of existence is — is the basic fact and insight of metaphysics. If you are going to understand metaphysics, you have to be able to focus on existence, as

such. However far away from home focus you get in a science of metaphysics, you need never to lose sight of the meaning of existence, and you need to be able to refer back to that when things get a little shaky or uncertain.

This is a type of inductive thinking in a philosophical way. Induction is moving from experience to understanding. In the world of objects, we form general ideas about classes of things. If we join Newton in studying objects, we can conclude, inductively, that all beings which have mass are attracted to each other by a force that we call gravity. That is a species of induction that we use throughout the fields of empirical science. If a phenomenon exhibits itself regularly in our experience, we make an induction from the reality which supports the experience. If all the lobsters we ever have seen are red, we make the empirical induction that "lobsters are red." If a blue lobster then comes waltzing down the pike, we may need to reformulate our generalization, but we would then tend to look for some more general principle which would underlie all the possible colors of lobsters.

"To be" is the fundamental act by which anything is real. That is a philosophical induction. It depends not on arraying different examples, but by attending to something which is fully exemplified in any primary exemplar. This is going to be what existence means. In saying that, although it may not be immediately evident, the immediate, and important, corollary is that existence doesn't mean anything else. For the sake of example, "to be" doesn't mean, in a metaphysical context, a word phrase joining two concepts. Nor does it mean a capability of being sensorially perceived under appropriate circumstances. It is important to establish this fundamental block in a rational metaphysics. It isn't saying a lot, but it is saying something crucially important.

Knowing God

The argument for the existence of God is a short one, if the foundation of metaphysics is clearly established and kept clearly in mind. A preliminary caution, however, is in order. And that is that a metaphysical argument isn't going to look like an argument that we use in any other context. The empirically trained consciousness is used to asking for "evidence," which tends to mean sensory data which can be arrayed to make a certain conviction more and more certain. That's usually what we mean when we're talking about arguing to the existence of anything. But that's not the way metaphysics works – and that's why it's uncomfortable for a mind not used to thinking that way.

The core insight in thinking about God is the observation that any particular existing thing in the world around us is something *which exists.* Everything with which we are in experiential contact is a limited way of existing. Limited: that is to say, an experiential thing is its own way of existing, and not just the same as anything else. By the very fact that something is specifically what it is, it is not something else. A cow, by being a cow, is limited to its cow-ness. A cow is not a horse. And, likewise, everywhere. Things are what they are, and by that very fact, not what they are not.

It is critical here to note that this is not just a matter of verbal definition. It is, rather, saying something about the way things are in themselves. Yet, it is critical here to note that making this observation is not a triviality. The self-identity of existing things, and their corollary limitedness, is an important aspect of things to realize and attend to. Things are what they are; they are not what they are not.

Existing is the most basic act of anything real. Existing is the act by which anything existing is real.

The next step in the argument is the observation that the nature of anything we know is not its existence. “Nature” is used here in a non-Aristotelian way. Nature here does not mean a form or a Platonic idea. It does point, however, to whatever Plato and Aristotle were trying to get at when they talked about ideals or forms. Without, however, trying to develop an ultimate meaning for nature, which is foreign to our interest here, by nature here we do mean the “whatness” of a thing. In this sense, it does not pertain to the whatness of a limited thing “to exist.” A horse is contingent thing. It could either exist or not exist, considered in itself.

Things can cause only to the extent and according to the capacity of what they are. The nature of any phenomenal thing is to exist in a certain way. It is not existence itself. Existence, however, must “come from” a mode of reality which in itself entails existence. The existence of anything must come from a mode of being the nature of which is, in itself, to exist.

The conclusion to this line of thought is that any limited existing thing – which is all we are in contact with in experience — entails a mode of existence the nature of which is simply “to exist.” Any thing – or the phenomenal universe in itself – entails existence which has reality, or existence, in itself. Existence “in itself' is what mankind throughout its long and tortuous history has been trying to get at when it has used the name “God.”

God exists, or nothing else could. It becomes quite a different issue to consider what God is “like,” if he (she, it), indeed is like anything we are familiar with.

The Metaphor of Cosmos I

We are now in a position to understand better the metaphor of Cosmos I. The basic reality of the universe is limitless being, being the nature of which is to exist. We can flesh that out somewhat, but that is the core intelligibility.

Looking back on the evolution of culture, there was a time at the beginning of the cultural adventure when science of any hue was distinguished by its absence. Our early attempts at understanding our universe were pre-scientific. We attacked the problems of survival with our brains and our brawn, which together exceeded the capacities of the animals with which we were in competition. Observations about the universe tended to be fairly close to the immediacy of sensory data, or imaginative extrapolations from the deep wells of biological symbolism.

By science here I mean a body of organized thought which develops theories which go beyond ordinary sensory experience, and claims ultimate authority in reference to an objective reality. Used in this sense, science can include both what we are familiar with in modem empirical science, or philosophies which put themselves forward as bodies of truth based not on belief or revelation from a divinity.

In this sense I include as science both the disciplines of modem empirical discovery, and also of a realistic metaphysics based on an analysis of existence, as has been here presented. The modem thinker will find this difficult to digest. “Science,” as we use it today — with reason — means the study of what can be seen or inferred from physical data. Science in that sense has been incredibly successful in disclosing for us the nature and constitution of the physical world. Far beyond what even the boldest of speculators might have guessed a couple of hundred years ago.

But, the problem with the universe is that it presents itself to us in such a fashion that its most basic realities are not susceptible of empirical observation or measurement. The constitutive dimensions of the world cannot be the objects of scientific investigation, in the narrow sense of science, since they are pervasive through all empirical data, and, in an existential sense, prior to empirical data. The primary examples of these prior aspects are 1) the fact that there is plan and specificity in the world, and 2) that the world exists at all. These are non-empirical data, in the sense of observational science.

Yet these are things we somehow know. And that knowledge does not have to be left gasping on the ground in an unreasoned state. We can develop a “science” of these “non-scientific” dimensions. If we do that, we are doing metaphysics. Just because metaphysics is “non-scientific” in the sense of measurable science doesn't mean we should give up on it. Although it grantedly is a tough job, we need to develop a consistent and durable metaphysics if we are going to understand the world in its fullness.

So, those things being understood, we need both empirical science and philosophical, or metaphysical science if we are going to deal adequately with the phenomena of a real, existing world. History is replete with botched attempts at getting these matters straight. That is too bad, but it need not deter us from doing it right. We need to keep hacking away at the problem until we've got it straight. Then we can move ahead more constructively.

The development of the world view of Cosmos I was anything but a simple endeavor. It was highly complex, and as much a product of the human imagination and intellect as anything ever has been. But, the considerations of Cosmos I did not develop an adequate methodology for dealing with

empirical data. There was a lot about the mindset of Cosmos I that was built on mythology and intuition.

There is a difference between having a proper knowledge of something, and having an intuitive or mythological knowledge of it. Our ancestors, who were every bit as bright as we, knew a lot about the world intuitively. The job of civilization and culture has been to get to know the world as it "really is," without the story and the metaphor. The problem with mythologies is that in stating something in an intuitive fashion, they may miss a good deal of the underlying reality: they may not stand up in the face of continuing experience. Intuitively, our ancestors sensed that there is some sort of order in the universe, and that it took infinite power to bring the universe into existence. They tended to personify the powers of nature and to create deities who were the cause and the overseers of things around us. "Everything is full of gods," as Thales, the ancient Greek, opined.

Cosmos I, then, was full of metaphor. Did God walk with Adam in the Garden of Eden? Metaphorically, yes. Did God reveal himself, and Truth, to mankind? Metaphorically, yes. Did sun, moon and stars whirl around the earth on crystal spheres? Metaphorically, yes. It is the job of metaphysical science to clarify what we mean in an elaborated sense by the belief that God made the world. It is the job of empirical science to clarify what objective truth has to say about the heavenly bodies going around the earth. Metaphysics deals with existence; empirical science deals with existents.

Overview

What we discover is that the world is in some ways the way we thought it to be, and in some ways quite different.

The task now is to refine our view and our definition of just how the universe is. To pass from metaphor to objectivity. In our enthusiasm over the strengths and achievements of empirical science, we should not pass over the important job of continuing to straighten out the philosophical mess that the evolution of empirical discovery has left in its wake. There are many interfaces where it is necessary to do good work. One of the most active of these is between Science (meaning empirical science) and Religion (meaning our actual religious traditions).

Although there is much in our religious tradition which may not be literally true, there are metaphorical truths there which may be of overarching importance, and which we do not wish, for good reason, to let slip from our grasp. *God and Atom* has been about this very important interface. It has been our objective here to offer some thoughts about a particular way of interpreting things, and to suggest some quite specific solutions for certain historical quandaries.

We can look back now over territory that we have covered. Our first observation was that there has been an inherent trickiness in the task of evolving within a pre-existing world. *Mundus mendax.* We were pre-destined to come up with some odd ideas about our world, for two controlling reasons: 1) we did not carry with us an active memory of our own development, primarily because that sort of active memory requires writing – a cultural genome – and it took us quite a while to get around to inventing writing; and 2) the world presents with surface phenomena — such as the Sun going around the Earth — which it takes considerable sophistication to get to the bottom of.

Next, we walked through a garden of Two Cosmoi. The first lasting from the dawn of time to the Renaissance, when Galileo (and friends) started looking through polished lenses at the planets, and started discovering all manner of curious

truths about our universe. During the dynamic experience of discovering Cosmos II, we have gone to the stars and the edges (if there are any!) of the material world, upwards; and to the molecules and atoms, downwards. Probing around with quantum mechanics, quarks and other subatomic mysteries, we find that things tend to become numbers, and we wonder, again, whether ultimate physical reality is "real stuff," or only force fields that we can understand only mathematically.

And, in the midst of the welter of phenomena coming into reality over time, we realize that the only way to see ourselves truthfully is as an evolutionary phenomenon with a specific history. This was a critically important fact that Cosmos I, for all its glory, had no way of getting in contact with. But, we find that matter has within itself ways of coding information which, on succeeding upward levels, has the capacity for instructing the processes of life. We watched the tremendous importance of Darwin's thought about natural selection, but then, having seen the power of that theory, we also considered its limitations. We speculated that life is a much more complicated system of multileveled feedback systems — and that, though systems exist of which he could not dream, Lamarck perhaps was not totally off the mark, either. But, beyond the process of biological encoding, evolution has then taken off through the production of the cultural genome, bringing us to where we are today.

Then, surveying knowledge, what emerges clearly is that empirical science is not enough, and, to see the universe fully, metaphysics, properly understood, is as necessary as physics, biology, or mathematics. Existence, as such, is not only the most basic aspect of everything real, it needs also to be an object of special study. And, what we discover it that the limited existence of everything we see about us

entails, ultimately, self-subsistent existence. Self-subsistent existence is what the minds of Cosmos I were striving to understand when they were trying to understand God — and the interaction of man with his universe through that ultimate limitless sea of infinite reality. And, we are not done yet.

Horizons

If there is one thing which crashes in upon us as we look around, it would be a ce1iain irritation at the complexity of our experience. Here it is, this human animal, this man, woman and child, waking up and striding innocently out into the morning of time, eager to understand, but not quite knowing what to expect. This ought to be easy — but it is not. The complexity of the venture seems like looking into experience and finding existential clockwork inside of clockwork, with bewildering intricacy and interdependent relationships. This all seems to be one glorious and overwhelming mess! Well, yes! That is true. Reality does not really seem to be for the faint of heart. Strange for it to be that way, but that is the actuality of things and the challenge! We can tum away from it, but we cannot escape it.

The mind – whatever else is true – is a tool and vehicle for comprehending reality and the universe. The road is rocky, and frequently difficult to traverse. And there are many side paths and cul-de-sacs from which there seems to be no egress, once one has wandered into them. But, there really isn't a great deal of choice, in terms of whether to follow the trails of truth, when one finds himself, herself, in the midst of things. We can tum aside, occupy ourselves with the trivia of daily living, and ignore the insistent urge of our

surroundings, clamoring to be understood. But, we have to start wherever we find ourselves. We can 't start from another universe, nor from a different place in this universe from the one into which fate and circumstances have cast us.

If we do decide that we are going to make a serious effort at understanding things, a certain amount of circumspection seems in order. It won't do to claim that we have more answers than we do. It won't do to claim that the small stake we have in knowledge and understanding is the sum total of all there is to be known, or even that our tack on things is exclusively correct. But, it equally won't do to throw up our hands and declare the world to be unknowable, or that all theories are only personal opinions. Some theories are better than others, and truth, although slippery and elusive is attainable.

A difficulty with our philosophical tradition, often, has been that it attempted to answer problems with a dearth of evidence. Answers about the real world cannot be answered in a vacuum. Thinkers in times past attempted to answer the problems of mind, body and spirit with only a smattering of the mind's biological underpinnings. As we continue to learn more and more about the way the brain works, and the ways in which our consciousness is supported by it, we will be able to couch the serious problems of mind in matter in more complete terms. We are not to the place, however, where we can erase all the mystery, or take away all the sticky problems.

Our world presents itself as something – or, better, a range of somethings, which *exist.* Both of those polarities are important for our understanding. In our approach to our universe, both physics and metaphysics are important. That is, *how* things exist, and *that* they exist at all. We are driven to the conclusion, if we stay with things, that limited being, considered in itself, makes an existential contradiction. That

is, as we have seen, that limited being entails unlimited existence: a regression *ad infinitum* cannot be the way the world is. That is because of the very nature of existence.

The mystery of mind in the universe has not disappeared because of our knowledge of mind as evolutionary from the backdrop of "inanimate" matter. There seems to be a very real sense in which the ultimate foundation of the universe is infinite existence and intelligibility. To the extent that things exist, they are intelligible, and that intelligibility seems inseparable from existence. In some sense the ultimate ground of existence and intelligibility is infinite, and that is what the human mind has been stretching towards which it has been out grubbing around the universe looking for God.

There continues to be value in mining the length and breadth of our historical experience. The human mind has tried out a lot of different approaches to the game of existence and its many ramifications, and we can continue to learn from both the positive and negative aspects of that continuing adventure. The contemplation of mystics and seers in all religious and philosophical traditions has not been vacuous. It has been communicating with aspects of the depths of reality which are real, possibly super-real. We can admire the super-consciousness of Saint Francis, and it would be folly to write off that dimension of existence as merely imaginary or self-stimulating. Mystics have been in touch with the deep realities of the universe in ways that escape the rest of us. The only problem with mysticism is that 1) it is useful primarily for the mystic himself/herself, and 2) there aren't any very good ways to extrapolate it, so that it is directly useful for the ongoing evolutionary experience. The real problem with mysticism is not that it doesn't deal with reality, but that it has direct utility only for

the mystic – and we would like something a bit more marketable in the agora of the mind.

Science and Religion

It is not accidental that over the last 10 years, or the last 50, depending on the breadth of the measurement, there has been an explosion of interest in the relationships between Science and Religion. There have been a flood of articles and books written by historians of thought, scientists, philosophers and theologians all attempting to shed light on interface between religious experience and scientific investigation. Thinkers have realized that somehow these two traditions are touching the universe in different places, from different perspectives, and that it is valuable for the race to continue to try to clarify the different ways in which scientists and religionists dig into the same phenomenologies of existence in different but complementary ways. These efforts will continue, until we get more and more to places where we can seamlessly share.

Our traditional religious are in a good deal of trouble. The intellectual tradition within religious study has fallen on difficult days. In a wry twist of cultural evolution, it has not been the more intellectual steams of religious thought and experience which have flourished, recently. Rather, it has been the more fundamentalist streams, where there is emphasis on the direct acceptance of revelation, and less and less on a natural understanding of things. It remains to be seen what good is going to come from this experience, whether fundamentalism is to become the surviving culture of religious tradition, or, instead, is a more passing phenomenon.

Foretelling the future is always a hazardous sort of activity to engage in, since we usually guess wrong about how reality will express itself in the future, yet having come this far, it is practically impossible not to attempt to gaze into the mists of the future. It seems highly improbable that we will abandon metaphysical truth and content ourselves with a combination of empirical investigation on the one hand, and fundamentalist religion on the other. That, were it to occur, would be a real abandonment of the intellectual quest, and it is more likely that the intellectual adventure will continue. We have not exhausted by any means the gold to be mined from "them thar hills."

In the meanwhile, while evolution continues its processes by investing in the adventure of discovery, the garden of everyday experience needs to be tended. The search for truth about ourselves and the universe is an insistent urge, but the world of practicalities calls out for its own attention. The riches of the world, whether spiritual or material, are very unevenly distributed among the family of man. The "first world" has continued to push ahead into discovery and technology, often leaving the "third world" woefully in its wake.

The first world has fed its needs for riches on an expansionist approach to productivity. As we continue down the stretches of the third millennium CE, we will be forced into looking at things in different ways. Expansionism necessarily results in injustice towards those who are left holding the dirty end of the stick. That is one moral reason why we need to look for more equitable ways of doing things. However, man in general, sad to say, infrequently reins in his aggrandizement on the basis of moral grounds alone. What will more effectively force us into looking for other equations is the fact that we have been rapidly expanding to the edges of possible human experience on the

planet. More and more, we will be reflecting back upon ourselves, and that, if not our altruism, will force us to reconsider some of the basic principles which have driven economic and political expansion.

We do not, however, know what the future of mind in the universe will be. It is highly unlikely that we have exhausted the possibilities of mind and of the processes of evolution. What does seem fairly certain is that the shape of the future world will to greater or less extent depend on the way we see things, and the way we make choices in the light of that understanding. There are very solid reasons for continuing to believe that God – self-existing reality – is the ultimate background for existence and experience. And that phenomenal mind, evolutionary in ourselves, somehow continues to develop into greater spheres of consciousness and realization.

From current vantage point, it is impossible to foresee how these issues will work themselves out. Yet the more we understand about things, the better choices we will be in a position to make. We know a great deal. There is still a lot that escapes us. It would seem to be a good thing to steer clear of destroying ourselves and all the things that human intelligence and energy have achieved. The evolution of mind is a continuation of processes that began in primordial seas so very long ago. What that means, and where it goes, remains to be seen.

impossible task. It is, in fact, a project that in very current time is being given new meaning and new depth by a spiritual and intellectual movement very particular to our own times. There is much nonsense and confusion afoot in the world. There is also an urgent sense that unification of knowledge is possible.

Over recent years (5 or 50, depending on where you wish to place the limits), a distinctly new project has arisen, a concerted effort to relate Science and Religion to each other, and to the ongoing stream of cultural significance. Nothing is so hard to stop as an idea whose time has come. The Science - Religion project is a tide not to be stemmed.

God and Atom, then, is a non-scholarly but hopefully significant contribution to this effort. It is a roadmap, rather than an encyclopedia, but it attempts to keep from sliding off into an abyss of doubt, or to miss the forest for the trees. If there is a single conclusion, it is that though our formal religions are in painful flux, they are still about something very real in our empirical universe. Science has given us an increasingly profound understanding of the physical world. But, the universe entails infinite power and infinite intelligence, and that is what, throughout the ages, men and women have referred to as God.

The adventure will continue. It is unlikely that we will ever as a race subscribe to an institutional orthodoxy, but our objective is not an impossible one, at all: to work together towards shared perspectives on the essential constitution of the universe and the meaning of human life. Truth, though slippery, is not arbitrary. We will need to tease out the exact significance of this, but the deepest reality in any existing universe is God.

COVER: Lessing J. Rosenwald Collection, Library of Congress.

Mundus Mendax

"The Deceitful World." When early man faced the challenging world around him, two aspects of his reality conspired to trick him: First, he did not carry with him an active memory of his true origins, and second, he had no reason to suspect how complicated was the substructure of the material world around him.

These two aspects of early human experience thwarted our early attempts to understand ourselves and our environment. Not recalling how we really evolved, we thought up mythological origins, which became deeply engrained in our culture. Further, we imagined top-down philosophical explanations for natural phenomena, rather than learning about cells and wavelengths from the bottom up.

When Galileo saw the moons of Jupiter through his primitive lenses and Newton worked out a mathematical equation for gravity, we started to see the world in an entirely new way, and the process of empirical discovery has continued with astounding rapidity and success to our own time.

Before the scientific explosion, we felt that the visible universe entailed an omnipotent and all-intelligent God. That insight happens to have been correct, although some of the dogmas and symbols we attached to the idea of God were more mythological than literally true. God is a metaphysical necessity, and there would be no universe without infinite power and intelligence.

There is a new loosely defined phenomenon: the Science and Religion Project. The motive for this project is clearer than its outcome. Science faces the realization that there are realities beyond atoms and supernovae. Religion recognizes the need for an empirically valid physical world in which to experience infinity.

Thousands of ordinary people and scholars are devoting resources to the project. We are experiencing a new dawning of spiritual awareness. It is possible, but not necessary, that our world is on the way to hell in a handbasket. We have something to say about that. It is important that we continue to grapple with the challenges presented by our marvelous universe.

ISBN 0-9748497-0-7

52495