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"The fear of the Lord is the beginning of Wisdom." Psalm 111:10

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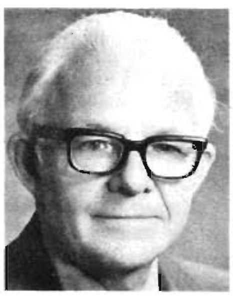
God's Perspective on Man



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Philosophy and science are both bafflingly inclusive in their subject-matter. Yet each of these disciplines is essentially an attempt to answer a simple question. Taken in its broadest sense, science is dedicated to the task of answering that question which perpetually haunts our minds, "How?" A simple question indeed! But to explain how grass grows on our earth or how a machine functions or how galaxies zoom through the vast emptiness of space has been one of the great enterprises of modern civilization, perhaps its greatest. On the other hand, philosophy, taken in its broadest sense, is also dedicated to the task of answering a simple question which never quits plaguing us, "Why?" Though the why-question like the how-question is deceptively simple, it often teases us nearly out of thought. So, for example, a child asks innocently, "Why was anything at all?"—and the sages are reduced to silence.

We who are amateurs in the philosophical enterprise find ourselves bewildered as we glance at its profusion of rival schools and listen to their in-group jargon. Fortunately, though, one of its most illustrious practitioners, Immanuel Kant, provides us with helpful orientation. In the *Handbook* which he prepared for the students who studied with him at the University of Koenigsburg a century and a half ago, Kant points out that philosophy, a disciplined attempt to explain why, concerns itself with four key-problems.[1] First, what can we know? Second, what ought we do? Third, what may we hope? Fourth, what is man? In a way that last question, "What is man?", the problem of anthropology or the nature of human nature, includes the other three. For man is that curious creature who insists on asking questions. Man is that unique animal who tirelessly cross examines himself about himself. Man is that relentless interrogator who probingly wonders what he can know and what he ought to do and what he may hope. Philosophy, therefore, twists and turns around the person and the philosopher. Every question he raises is inescapably enmeshed with the question concerning himself as the questioner, "What is man?"

The fourth key-problem in Kant's succinct outline of philosophy echoes a recurrent Biblical theme. In

Job 7:17 that very question appears. In Psalm 8:4 that question re-emerges, and Hebrews 2:5 repeats that same question. Thus we are not surprised that philosophy, which like theology is a why discipline, puts anthropology or the problem of man front and center. But whether we label ourselves philosophers or theologians or scientists, every one of us is a human being who grapples with the issue of self-identity. Hence the question, "What is man?", concerns us individually at the deepest levels of our existence; for that question is really the haunting question, "Who am I?"

Man as Garbage

Before proceeding to present God's perspective on man, which can be done only because we presuppose that the Bible is God's Word spoken to us through human words, let me remind you of some competing models of man that are widely accepted today. There is of course the purely materialistic concept which holds that man is nothing but, as Bertrand Russell elegantly phrased it, an accidental collocation of atoms. This concept, though advanced with the blessing of contemporary science, is by no means excitingly novel. In the 18th century self-styled *illuminati* scoffed that man is nothing but an ingenious system of portable plumbing. In pre-Hitler Germany an unflattering devaluation of *Homo sapiens* was jokingly circulated: "The human body contains enough fat to make 7 bars of soap, enough iron to make a medium sized nail, enough phosphorus for 2000 matchheads, and enough sulphur to rid oneself of fleas." When human bodies were later turned into soap in the extermination camps, the grim logic of that joke was probably being worked out to its ultimate conclusion.

Today, tragically, that concept, apparently certified by science, is articulated by a celebrated novelist like Joseph Heller. In *Catch 22* he describes a battle. Yossarian, the book's hero, discovers that Snowden, one of his comrades, has been mortally wounded. Hoping that none of us will be unduly nauseated by it, I quote this vivid passage.

> Yossarian ripped open the snaps of Snowden's flack suit and heard himself scream wildly as Snowden's insides slithered down to the floor in a soggy pile and just kept dripping out. A chunk of flack more than three inches big had shot into his other side just underneath the arm and blasted all the way through, drawing whole mottled quarts of Snowden along with it through the gigantic hole it made in his ribs as it blasted out. Yossarian screamed a second time and squeezed both hands over his eyes. His teeth were chattering in horror. He forced himself to look again. Here was God's plenty all right, he thought bitterly as he stared—liver, lungs, kidneys, ribs, stomach and bits of the stewed tomatoes Snowden had eaten that day for lunch. Yossarian . . . turned away dizzily and began to vomit, clutching his burning throat . . .
>
> "I'm cold," Snowden whimpered. "I'm cold."
>
> "There, there," Yossarian mumbled mechanically in a voice too low to be heard. "There, there."
>
> Yossarian was cold too, and shivering uncontrollably. He felt goose pimples clacking all over him as he gazed down despondently at the grim secret Snowden had spilled all over the messy floor. It was easy to read the message in his entrails. Man was matter, that was Snowden's secret. Drop him out a window and he'd fall. Set fire to him and he'll burn. Bury him and he'll rot like other kinds of garbage. The spirit gone, man is garbage. That was Snowden's secret.[2]

Man is garbage. That, crudely stated, is a common view of human nature today. In the end, man is garbage—an accidental collocation of atoms, destined, sooner or later, to rot and decay. To guard against any misunderstanding, let me say emphatically that from one perspective man is indeed garbage or will be. That appraisal is incontestably valid, provided man is not viewed as garbage and nothing but that. Man has other dimensions to his being which no full-orbed anthropology can ignore.

Man as Machine

A second concept, apparently endorsed by science, holds that man is essentially a machine, an incredibly complicated machine, no doubt, yet in the end nothing but a sort of mechanism. Typical is the opinion of Cambridge astronomer, Fred Hoyle, who writes in *The Nature of the Universe*:

> Only the biological processes of mutation and natural selection are needed to produce living creatures as we know them. Such creatures are no more than ingenious machines that have evolved as strange by-products in an odd corner of the universe . . . Most people object to this argument for the not very good reason that they do not like to think of themselves as machines.[3]

Like it or not, however, Hoyle insists, that is the fact. What is man? An ingenious machine—well, a whole complex of machines. R. Buckminster Fuller, whose genius seems to belie the truth of reductive mechanism, pictures man as

> a self-balancing, 28 jointed, adapter-based biped, an electro-chemical reduction plant, integral with the segregated storages of special energy extracts in storage batteries, for the subsequent actuation of thousands of hydraulic and pneumatic pumps, with motors attached; 62,000 miles of capillaries, millions of warning signals, railroad and conveyor systems; crushers and cranes . . . and a universally distributed telephone system needing no service for seventy years if well managed; the whole extraordinary complex mechanism guided with exquisite precision from a turret in which are located telescopic and microscopic self-registering and recording range finders, a spectroscope, *et cetera*.[4]

That man from one perspective is a complex of exquisitely synchronized machines cannot be denied and need not be, provided human beings are not exhaustively reduced to that, and nothing but that. Man has other dimensions to his being which no full-orbed anthropology can ignore.

Man as Animal

Still another current concept of man holds that he is essentially an animal. Loren Eiseley, a distinguished scientist whose prose often reads like poetry, eloquently sets forth this model of humanity in his 1974 *Encyclopedia Brittanica* article, "The Cosmic Orphan." What is man? He is a cosmic orphan, a primate which has evolved into a self-conscious, reflective, symbol-using animal. Man is a cosmic orphan, a person aware that he has been produced, unawares and unintentionally, by an impersonal process. Thus when this cosmic orphan inquires, "Who am I?", science gives him its definitive answer.

> You are a changeling. You are linked by a genetic chain to all the vertebrates. The thing that is you bears the still-aching wounds of evolution in body and in brain. Your hands are made-over fins, your lungs come from a swamp, your femur has been twisted upright. Your foot is a re-worked climbing pad. You are a rag doll resewn from the skins of extinct animals. Long ago, 2 million

> years perhaps, you were smaller; your brain was not so large. We are not confident that you could speak. Seventy million years before that you were an even smaller climbing creature known as a tupaiid. You were the size of a rat. You ate insects. Now you fly to the moon.

Science, when pressed, admits that its explanation is a fairy tale. But immediately science adds:

> That is what makes it true. Life is indefinite departure. That is why we are all orphans. That is why you must find your own way. Life is not stable. Everything alive is slipping through cracks and crevices in time, changing as it goes. Other creatures, however, have instincts that provide for them, holes in which to hide. They cannot ask questions. A fox is a fox, a wolf is a wolf, even if this, too, is illusion. You have learned to ask questions. That is why you are an orphan. *You are the only creation in the universe who knows what it has been.* Now you must go on asking questions while all the time you are changing. You will ask what you are to become. The world will no longer satisfy you. You must find your way, your own true self. "But how can I?" wept the Orphan, hiding his head. "This is magic. I do not know what I am. I have been too many things." "You have indeed," said all the scientists together.

Something still more must be appended, though, science insists as it explains man to himself.

> Your body and your nerves have been dragged about and twisted in the long effort of your ancestors to stay alive, but now, small orphan that you are, you must know a secret, a secret magic that nature has given you. No other creature on the planet possesses it. You use language. You are a symbol-shifter. All this is hidden in your brain and transmitted from one generation to another. You are a time-binder; in your head the symbols that mean things in the world outside can fly about untrammeled. You can combine them differently into a new world of thought, or you can also hold them tenaciously throughout a life-time and pass them on to others.[5]

Expressed in Eiseley's semi-poetic prose, this concept, while confessedly a fairy tale, has about it an aura of not only plausibility but nobility as well. Sadly, however, when man is reduced to an animal and nothing but an animal, the aura of nobility vanishes and bestiality starts to push humanity into the background. Think of man as portrayed in contemporary art and literature and drama. Take, illustratively, the anthropology which underlies the work of a popular playwright like Tennessee Williams. What is the Good News preached by this evangelist, as he calls himself? His Gospel, interpreted by Robert Fitch, is this:

> Man is a beast. The only difference between man and the other beasts is that man is a beast that knows he will die. The only honest man is the unabashed egotist. This honest man pours contempt upon the mendacity, the lies, the hypocrisy of those who will not acknowledge their egotism. The one irreducible value is life, which you must cling to as you can and use for the pursuit of pleasure and of power. The specific ends of life are sex and money. The great passions are lust and rapacity. So the human comedy is an outrageous medley of lechery, alcoholism, homosexuality, blasphemy, greed, brutality, hatred, obscenity. It is not a tragedy because it has not the dignity of a tragedy. The man who plays his role in it has on himself the marks of a total depravity. And as for the ultimate and irreducible value, life, that in the end is also a lie.[6]

These, then, are three contemporary models of man, all of them rooted in a philosophy of reductive naturalism. First, man is nothing but matter *en route* to becoming garbage. Second, man is nothing but a complex of exquisitely synchronized machines. Third, man is nothing but an animal, a mutation aware that, as a cosmic orphan, it lives and dies in melancholy loneliness.

Man is garbage, machine, animal—and image of God.
God's model of authentic personhood is Jesus Christ.

Man as God's Creature

Now over against these views let us look at man from God's perspective, unabashedly drawing our anthropology from the Bible. As we do so, please bear in mind that we are not disputing those valid insights into the nature of human nature which are derived from philosophy, no less than science. Suppose, too, we take for granted that psychology and sociology are properly included within the scientific orbit. In other words, we are assuming that man is multidimensional and that anthropology therefore requires God's input if it is to give us a full-orbed picture of its subject.

To begin with, then, the Bible asserts that man is *God's creature*. So in Genesis 2:7 this statement is made: "The Lord God formed man of dust from the ground and breathed into his nostrils the breath of life and man became a living soul." Exactly how God formed man Genesis does not tell us; it does tell us, though, that man is not an accident, a happenstance, a personal mutation ground out by an impersonal process. On the contrary, Genesis tells us explicitly that man owes his existence to God's limitless power, wisdom, and love. It tells us explicitly that man—dust inbreathed by deity—cannot be explained except in terms of creaturehood. Which means what? As creature, man is qualitatively different from God, utterly dependent upon God, and ultimately determined by His creator. It is God Who determines man's nature and determines, likewise, the laws and limits of human existence.

Obviously, the implications of this Creator-creature relationship are enormous. Few reductive naturalists have perceived them as penetratingly as Jean-Paul Sartre, the foremost spokesman for atheistic existentialism now living. Realizing what follows if indeed man has been made by God, Sartre repudiates the very notion of creation. Understandably so! If there is no Creator, then there is no fixed human nature, and man has unbounded freedom. He can decide who he will be and what he will do. That is why Sartre postulates atheism without stopping to argue for it.

> Atheistic existentialism, which I represent, states that if God does not exist, there is at least one being in whom existence precedes essence, a being who exists before he can be defined by any concept, and that this being is man, or, as Heidegger says, human reality. What is meant here by saying that existence precedes essence? It means that, first of all, man exists, turns up, appears on the scene, and, only afterwards, defines himself. If man, as the existentialist conceives him, is indefinable, it is because at first he is nothing. Only afterward will he be something, and he himself will have made what he will be. Thus, there is no human nature, since there is no God to conceive it. Not only is man what he conceives himself to be, but he is also only what he wills himself to be after this thrust toward existence. . . . If existence really does precede essence, there is no ex-

> plaining things away by reference to a fixed and given human nature. In other words, there is no determinism, man is free, man is freedom. On the other hand, if God does not exist, we find no values or commands to turn to which legitimize our conduct. So, in the bright realm of values, we have no excuse behind us, nor justification before us. We are alone, with no excuses.[7]

Thus in Sartre's opinion only if man is not a creature can he be genuinely free, free to shape his own nature, free to run his own life, free to pick and choose his own values. And Sartre is right. Grant that man is a creature, and you must grant that he can never sign a declaration of independence, cutting himself free from God. He is inseparably related to God, finding fulfillment and obedience to his Maker's will. Hence Paul Tillich, in tacit agreement with Sartre, argues that the modern repudiation of God springs from man's fierce desire to renounce his creaturely status. In Tillich's own words:

> God as a subject makes me into an object which is nothing more than an object. He deprives me of my subjectivity because he is all-powerful and all-knowing. I revolt and try to make him into an object, but the revolt fails and becomes desperate. God appears as the invincible tyrant, the being in contrast with whom all other beings are without freedom and subjectivity. He is equated with the recent tyrants who with the help of terror try to transform everything into a mere object, a thing among things, a cog in the machine they control. He becomes the model of every thing against which Existentialism revolted. This is the God Nietzsche said had to be killed because nobody can tolerate being made into a mere object of absolute knowledge and absolute control. This is the deepest root of atheism.[8]

Tillich, alas, grossly misconceives the Creator-creature relationship; but one thing he profoundly apprehends. Man as God's creature can never sign a declaration of independence from his Creator. That is the basic fact of human existence.

Man as God's Image

In the next place, the Bible asserts that man is *God's image*. Genesis 1:26 announces this second momentous fact of human existence rather undramatically. "And God said, Let us make man in our image, after our likeness." To interpret the full significance of the intriguing phase, the image of God, is plainly beyond my competence. But its central thrust is undebatable. Man was created not only by God and for God but also like God. He was created a finite person reflecting the being of infinite Personhood. Qualitatively different from God and absolutely dependent upon his Creator, man was endowed with the capacity of responding to the divine Person in love and obedience and trust, enjoying a fellowship of unimaginable beatitude.

My purpose is not to defend the audacious claim that the unimpressive biped whom Desmond Morris labels the naked ape is indeed God's image. But that audacious claim loses at least some of its initial incredibility when one takes into account man's extraordinary characteristics. These have been succinctly summarized by Mortimer J. Adler in that study, *The Difference of Man and the Difference It Makes*, which challenges reductive naturalism to rethink its inadequate anthropology.

> 1. Only man employs a propositional language, only man uses verbal symbols, only man makes sentences; i.e., only man is a discursive animal.
>
> 2. Only man makes tools, builds fires, erects shelters, fabricates clothings; i.e., only man is a technological animal.
>
> 3. Only man enacts laws or sets up his own rules of behavior and thereby constitutes his social life, organizing his association with his fellows in a variety of different ways; i.e., only man is a political, not just a gregarious, animal.
>
> 4. Only man has developed, in the course of generations, a cumulative cultural tradition, the transmission of which constitutes human history; i.e., only man is a historical animal.
>
> 5. Only man engages in magical and ritualistic practices; i.e., only man is a religious animal.
>
> 6. Only man has a moral conscience, a sense of right and wrong, and of values; i.e., only man is an ethical animal.
>
> 7. Only man decorates or adorns himself or his artifacts, and makes pictures or statues for the non-utilitarian purpose of enjoyment; i.e., only man is an aesthetic animal.[9]

Man, the animal who is discursive, technological, political, historical, religious, ethical, and aesthetic, certainly seems unique enough to lend some plausibility to the Biblical claim that he was created in God's image. That audacious claim, which does not impress Adler as preposterous, also receives powerful endorsement from the well-known physicist, William G. Pollard. How better, he inquires, can man be designated than the image of God? His cogent argument for this position cannot now be rehearsed; but his conclusion, it seems to me, deserves to be heard even by those of us who are anti-evolutionists:

> Starting from the perspective of the mid-twentieth century, we are able to see two very fundamental aspects of the phenomenon of man which would not have been evident before. One of these is the conversion of the biosphere into the noosphere. The other is the miraculous correspondence between the fabrications of man's mind and the inner design of nature, as evidenced by the applicability of abstract mathematical systems to the laws of nature in physics. Both of these quite new perspectives strongly support the contention that man is after all made in the image of God. What we have come to realize is that there is no scientific reason why God cannot create an element of nature from other elements of nature by working within the chances and accidents which provide nature with her indeterminism and her freedom. We also see in a new way that the fact that man is indeed an integral part of nature in no way precludes his bearing the image of the designer of nature. Or to put it another way, there is nothing to prevent God from making in His image an entity which is at the same time an integral part of nature.[10]

Regardless of how persuasive or unpersuasive we may judge Pollard's argument to be, the belief that man is God's image supplies the only solid ground for that much-praised, much-prized value of Western civilization—man's inherent dignity. For what is it that imbues man with dignity? If he is nothing but garbage or a complex mechanism or an over-specialized animal, why ascribe to him a worth that is literally incalculable? Why follow the teaching of Jesus Christ and impute to human beings a dignity which is best articulated by the phrase, the sacredness of personality? That Jesus Christ does impute so high a dignity to human beings is indisputable in the light of the Gospel. Indeed, He imputes to human beings a dignity so high as to dichotomize nature. On the one side, Jesus Christ puts the whole of created reality; on the other, He puts man; and axiologically, or in terms of his worth, man outweighs nature. Thus in Matthew 6:28-30 our Lord as-signs to man a worth above and beyond the whole botanical order. "Consider the lilies of the field, how they grow; they toil not, neither do they spin: And yet I say unto you, That even Solomon in all his glory was not arrayed like one of these. Wherefore, if God so clothe the grass of the field, which today is, and tomorrow is cast into the oven, shall he not much more clothe you, O ye of little faith?" But why is man, if merely one more emergent in the evolutionary process, valued above and beyond rarest roses or exotic orchids?

Again, in Matthew 10:29-31 our Lord imputes to man a worth above and beyond the whole avian order. "Are not two sparrows sold for a farthing? and one of them shall not fall on the ground without your Father. But the very hairs of your head are all numbered. Fear ye not therefore, ye are of more value than many sparrows." But why is man valued above and beyond parakeets and falcons?

Once more, in Matthew 12:12 our Lord imputes to man a worth above and beyond the whole zoological order as He exclaims, "How much more valuable is a person than a sheep!" Come to Denver for the National Western Stock Show held annually in January, and you will be astonished at the fabulous prices paid for champion steers, as much as $52,000. Remember by contrast that an average person even in today's inflated economy is worth about one dollar chemically. Then why is man valued above and beyond blue-ribbon steers?

Furthermore, in Matthew 16:26 our Lord imputes to man a worth above and beyond the whole sweep of created reality. "What shall it profit a man if he gains the whole world and loses his own soul? Or what shall a man give in exchange for his soul?" Why does Jesus Christ value man above the entire planet and beyond all the cosmos? Why? Man is unique because he alone is God's image-bearer; and as such he possesses inherent dignity and incalculable worth. As finite person reflecting the inexhaustible realities and mysteries of infinite Personhood, he cannot be valued too highly.

Yet of what practical significance is this evaluation of man, grounded in his dignity as the image of God? Is not this belief just one more element in an outmoded theology? Let Leslie Newbigin answer.

> During World War II, Hitler sent men to the famous Bethel Hospital to inform Pastor Bodelschwingh, its director, that the State could no longer afford to maintain hundreds of epileptics who were useless to society and only constituted a drain on scarce resources, and that orders were being issued to have them destroyed. Bodelschwingh confronted them in his room at the entrance to the Hospital and fought a spiritual battle which eventually sent them away without having done what they were sent to do. He had no other weapon for the battle than the simple affirmation that these were men and women made in the image of God and that to destroy them was to commit a sin against God which would surely be punished. What other argument could he have used?[11]

Yes, and what other argument was needed? Abandon belief in man as God's image, and in the long run you abandon belief in human dignity.

Man as God's Prodigal

In the third place, the Bible asserts that man is *God's prodigal*. Plants, birds, animals are instinctually programmed. They move in a predictable course from birth to death. But man is that peculiar creature who, possessing intelligence and fredom, may choose to behave in ways that are self-frustrating and self-destructive. The Spanish philosopher, Ortega Y. Gassett, remarks that, "While the tiger cannot cease being a tiger, cannot be detigered, man lives in a perpetual risk of being dehumanized."[12] Why, though, is man always in danger of failing to become what he potentially could be? Why does he, as a matter of fact, live in a state of ambivalence and contradiction, the animal whose nature it is to act contrary to his nature? Back in 1962 Dr. Paul MacLean suggested, some of you may recall, the theory of schizophysiology, speculating that man is radically self-divided because he has inherited three brains which are now required to function in unity. The oldest of these is reptilian; the second is derived from the lower animals; the third and most recent is the source of man's higher mental characteristics. Hence the brain of *Homo sapiens* is the scene of unceasing tension. Why wonder, therefore, if unlike other animals he is erratically unpredictable?

Arthur Koestler, too, has indulged in speculation as to why man finds himself in a constant state of self-contradition. In his 1968 book, *The Ghost in the Machine*, he advances a novel theory.

> When one contemplates the streak of insanity running through human history, it appears highly probably that *homo sapiens* is a biological freak . . . the result of some remarkable mistake in the evolutionary process . . . Somewhere along the line of his ascent, something has gone wrong.[13]

I will not stop to consider Koestler's suggestion that with the help of psychopharmocology the evolutionary mistake which is man may hopefully be corrected. I simply inquire as to what has gone wrong. Koestler has his own conjecture, but I prefer to accept the explanation advanced in Scripture. Man, instead of living in a self-fulfilling fellowship with God, a fellowship of trust and obedience and love, misused his freedom. He did as the younger brother did in our Lord's parable of the prodigal son: he turned away from his Father in the name of freedom. Man chose in an aboriginal catastrophe to transgress the laws and limits established by his Creator. He became a rebel. Thus God cries out in Isaiah 1:2, "I have brought up children and they have rebelled against me," a lament which echoes beyond the Jewish nation and reverberates over the whole human family. A planetary prodigal, man is thus in self-willed alienation from God, an exile wandering East of Eden, squandering his patrimony (think of our problems of pollution and starvation), living in misery and frustration, unable to be what he ought to be and to do what he ought to do, self-divided and self-destructive. The Biblical view of man as God's image who is now God's prodigal, a rebel and a sinner, impresses many of our contemporaries as incredibly mythological. Yet it impresses some of us as more congruent with the realities of history, psychology, and sociology that any of its secular rivals.

Man as God's Problem

In the fourth place, the Bible, which we believe gives us God's perspective on man, asserts that man, God's creature, God's image, God's prodigal, has become *God's problem* through the aboriginal catastrophe of self-chosen alienation. Joseph Wood Krutch, a noted student of literature who retired to Arizona and there devoted himself to the study of nature, sat one day on a mountain pondering a wild idea. What if in the creative process God has stopped after the fifth day? What if there had been no sixth day which saw the advent of man? Would that have been a wiser course for infinite wisdom to follow? After all, we read in Genesis 6:5,6 that God indulged in some sober second thoughts about man, His own image turned into a prodigal. "And God saw that the wickedness of man was great in the earth, and that every imagination of the thoughts of his heart was only evil continually. And it repented the Lord that he had made man on the earth, and it grieved him at his heart." One might interpret the judgment of the flood as a sort of huge eraser which God used to rub out His mistake!

Moreover, the Bible does not hesitate to say that man, God's image and God's prodigal, has become God's heartache. Yes, unhesitatingly, the Bible describes the divine reaction to human sin as a reaction of intensest grief. So in the prophecy of Hosea 11 we come across a text which, granting that the language is anthropopathic or attributing human emotions to God, portrays a heartbroken Creator:

> When Israel was a child I loved him as a son and brought him out of Egypt. But the more I called to him, the more he rebelled, sacrificing to Baal and burning incense to idols. I trained him from infancy, I taught him to walk, I held him in my arms. But he doesn't know or even care that it was I who raised him. As a man would lead his favorite ox, so I led Israel with my ropes of love. I loosened his muzzle so he could eat. I myself have stopped and fed him. . . . Oh, how can I give you up, my Ephraim? How can I let you go? How can I forsake you like Adam and Zeboiim? My heart cries out within me; how I long to help you!

Listening to that pathetic outpouring over the people of Israel and by extension over people everywhere, we turn back in memory to the day in the first century when God incarnate looked upon the city of Jerusalem and wept.

God's creature and God's image, self-constituted as God's prodigal, man is not only God's heartache but also *God's problem.* What can the Creator do with the creature who has rebelliously prostituted his God-bestowed capacities? Should God admit failure? Should God destroy man as a tragic blunder? Should He send this sinful creature into eternal exile? God, if I may be allowed an anthropomorphism no more crude than those the Bible uses, has a God-sized problem on His hands. In His holiness He cannot wink at sin, pretending it does not matter. He cannot lightly pardon man's guilty disobedience. No, His justice requires that the sinner be punished; and yet to send man into eternal exile would mean the frustration of God's very purpose in creating this creature. For as best we can infer from the Bible, God Who is love was motivated by love to expand the orbit of beatitude by sharing His own joyful experience of love with finite persons who could respond to His love with their love. So what can God do? Blot out His blunder and stand forever baffled in the fulfillment of His desire by the will of a mere creature? God's dilemma is brought to a sharp focus in Romans 3:25, where the apostle Paul writes that God must be just while at the same time somehow justifying the sinner. God must remain loyal to the demands of His holiness and justice, yet forgive man, cleanse him, transform him, and only then welcome him into the eternal fellowship of holy love. This is certainly a God-sized problem, a dilemma which might seem to baffle even the resources of Deity.

But the Gospel is Good News precisely because of the amazing strategy by which God resolves His own God-sized dilemma. And that strategy is the amazing strategy of the Cross. Incarnate in Jesus Christ, a Man at once truly divine and truly human, God dies on the cross bearing the full burden of the punishment human sin deserves. But in His Easter victory He breaks the power of the grave. And now He offers forgiveness, cleansing, transformation, and eternal fellowship with Himself to any man, who magnetized by Calvary love, will respond to the Gospel in repentance and faith. This, most hastily sketched, is God's solution to the problem of man. What a costly solution! Its cost, not even a sextillion of computers could ever compute!

I am one of those rather weakminded people who find chess too exhausting for their feeble brains. But I admire those intelligences of higher order who can play that intricate game with ease and pleasure. Paul Morphy, in his day a world champion chessman, stopped at an art gallery in England to inspect a painting of which he had often heard, "Checkmate!" The title explained the picture. On one side of the chessboard sat a leering devil; opposite him was a young man in despair. For the artist had so arranged the pieces that the young man's king was trapped. "Checkmate!" Intrigued and challenged, Morphy carefully studied the location of the pieces. Finally he exclaimed, "Bring me a chess board. I can still save him." He had hit on one adroit move which changed the situation and rescued the young man from his predicament. That is what God has done for all of us in Jesus Christ. By the mind-stunning maneuver of the Christ-event He has provided salvation from the consequences of our sin. He has opened up the way for His prodigals in their self-imposed exile to return home, forgiven, restored, welcomed unconditionally into the Father's loving fellowship.

Man's Possibility

Having discussed man's origin, and nature—man as God's creature, image, prodigal, and problem—may I merely mention man's possibility as Biblically disclosed? For Scripture asserts that by repentance and faith man may enter into a new relationship with God, becoming *God's child, God's friend, God's colaborer*, and so being *God's glory* in this world and the world beyond time and space.

Instead of existing as Eiseley's cosmic orphan, man can enter into a filial relationship of obedient love with the Heavenly Father. Instead of existing in hostile estrangement from God, man can enter into a relationship with his Creator which is akin to the intimacy of mature friendship on its highest plane. Instead of existing in frustration, feeling that all his labor is a futile business of drawing water in a sieve, man can enter into a relationship of cooperative creativity with God; he can find fulfillment as he develops the potentials of our planet and eventually perhaps those of outer space. He can find fulfillment, too, functioning in his society as salt and light and yeast. He can also find fulfillment as he follows the law of neighbor love, sharing whatever good he may have, and sharing especially the Good News that God in love longs for the human family to be coextensive with His divine family. Instead of anticipating blank nonentity after he has died, man can enter into a relationship with God which will last through death and on through eternity as a conscious union of finite persons with infinite Person.

What a magnificent model of man this is! What a gulf stretches between it and those models of man proposed by reductive naturalism! So I close by voicing my agreement with that perceptive Jewish scholar, Abraham Heschel.

> It is an accepted fact that the Bible has given the world a new concept of God. What is not realized is the fact that the Bible has given the world a new vision of man. The Bible is not a book about God; it is a book about man.
>
> From the perspective of the Bible:
> Who is man? *A being in travail with God's dreams and designs*, with God's dream of a world redeemed, of reconciliation of heaven and earth, of a mankind which is truly His image, reflecting His wisdom, justice and compassion. God's dream is not to be alone, to have mankind as a partner in the drama of continuous creation.[14]

I agree with that enthusiastically—except that in my opinion the Gospel of Jesus Christ adds to Heschel's statement heights and depths which Old Testament anthropology only intimates.

In all of our work, then, whether in science or any other vocation, may we strive to see man from God's perspective, remembering that God's model of authentic personhood is Jesus Christ. May our anthropology be more than a theoretical conviction. May it serve as a dynamic which shapes our own lives.

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Electrical Stimulation of the Nervous System for the Management of Neurological Disorders

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The approach that this paper takes to the theme, "What is Man?", is to look at man as a machine. By understanding the mechanistic characteristics, particularly of the nervous system, we can learn how to compensate for disorders related to the nervous system. With our increasing knowledge of neuroanatomy and neurophysiology and the advances in electronic technology, we are understanding and practicing nondestructive approaches to the long-term management of these disorders.

A Long History

An electrical approach to pain management was used in Rome around 46 A.D. according to medical historians. The agent was the black torpedo fish that was found along the shores of the Mediterranean Sea. The pain of gout was eliminated when the afflicted stood in a pool with these fish, and headache was relieved by the application of the fish to the head. More than 200 years ago in England, John Wesley, the founder of many social reforms including free clinics and founder of the Methodist Societies, used electrical stimulation as a "natural and easy method of curing most disorders". When his brother, Charles, was critically ill he sent the following instructions to a friend:

> "1. Carry Dr. Whitehead to him, whether my brother consents or not;
> 2. get him outdoor exercise if possible;
> 3. let him be electrified—not shocked but filled with electric fire; and
> 4. inquire if he has made his will."

As long as people have been able to generate electricity it has been applied to people in an attempt to cure their ailments. John Wesley, as well as others, used the spinning discs of the electrostatic generator, at that time the most readily available source of electricity.

Later, around 1800, a new source of electricity became available. Volta discovered how to use two dissimilar metals to produce electricity, the beginning of the electric battery. At the same time, Galvani discovered what was later referred to as "intrinsic animal electricity" (in species other than the electric fish). Hence the discovery and significant realization that people might be running on electricity. Since that time there have been many examples of using electricity to alleviate the physical (and even mental) disorders of people. The extent to which electricity was used in medicine is seen in the book *Electricity in Medicine*, published in 1919. The authors, Jacoby and Jacoby, described a variety of methods of applying electricity to the body to cure just about every known human ailment. Electrification of the whole body was easily achieved by placing the electrodes of the electrical generator in the bath water, for example. However, not all procedures proved to be effective and soon the use of electricity as described by the Jacobys subsided. The continued use of electricity on people was limited primarily to muscle stimulation, diathermy and electrocoagulation.

However, studies of the effects of electrical stimulation continued, particularly with animal preparations. In 1956, researchers found that the reactions of animals to painful stimuli of the limbs were eliminated when the spinal cord was electrically stimulated. These experimenters were seeking an understanding of the physiological basis for pain and its control and proposed a theory that a "gate" mechanism in the spinal cord could account for their observations. Others investigated this theory and participated in the development of implantable electrical stimulators for the management of chronic pain. The implantable stimulator consisted of a small radio receiver that was attached to small wires that penetrated the spinal cord. The receiver was tuned to a special battery-powered transmitter, which the patient was able to control.

The sensation experienced by the patient is usually a tingling in the area of the pain. In general, about ten minutes of stimulation produced several hours of relief of a previously intractable chronic pain. However, not all patients responded favorably to the implanted system. Either the electrical stimulation was ineffective or the tingling sensation was too unpleasant. It became apparent that the patients should be screened to determine whether a stimulator should be implanted or not. To do this, electrodes (EKG patches) were placed on the skin over or near the painful areas and then connected to an external pulse generator. Most often it was found that this external application was sufficient to give pain relief while the stimulator was on. In addition, in some cases several hours of relief were obtained after a few minutes of stimulation. Hence, electrical stimulation on the skin for pain management was rediscovered. In contrast to the equipment that was used earlier in history, the modern pulse generators contain means for very carefully controlling the amount of current delivered. The controls for the amount of current used are available to the patient. The sensations on the skin are varied. Examples of sensations that have been reported are massage-like, vibrations, and pins and needles.

With the latest achievements in technology, including the miniaturization of electronic systems, sophisticated applications of electricity to the body can be effective for many neurological disorders.

Neuroanatomy and Neurophysiology

Nerve Cells—The nervous system is composed of specialized cellular units or nerve cells called neurons that are linked together by special junctions to form pathways for the nerve impulses. The longest neurons (single cells) extend from the toes to the brain stem. These cells make up the electrical circuits and produce the electricity that was discovered in the 1800's. Of course this is not the same form of electricity as that produced by the utility companies for heat and light. Although electricity is the movement of electric charges, utility company electricity is the movement of free electrons in a metallic conductor whereas body or nervous system electricity is produced by the ions of the chemicals in and around the nerve cells. Electrical impulses in a wire are produced by the electrons moving momentarily in one direction but electrical impulses in nerves are much more complex. A crude analogy would be the chemical change along a firecracker fuse after it is ignited. The nerve, however, recovers from its chemical changes and is able to propagate another impulse very soon after the preceding impulse. The electrical impulse in a wire travels instantaneously, for all practical purposes. In contrast, tbe nerve impulse travels quite slowly, about twenty meters in one second.

The nerve impulse can be initiated in a nonphysiological way by an electrical or a mechanical disturbance of the chemical or structural environment of the nerve cell. Some examples of uncontrolled stimulation of the nervous system are: striking the ulnar nerve in the elbow, which produces a sharp tingling sensation in the lower arm and hand, and sticking the fingers in an empty, energized lamp socket, which produces tingling in the fingers.

Nervous System—The nervous system, which contains billions of neurons, consists of the central nervous system and the peripheral nervous system. Certain specialized anatomical structures, namely the cerebrum, cerebellum, brain stem and spinal cord make up the central nervous system. The whole system can be divided also into the sensory and the motor systems. Both of these systems contain ascending and descending pathways, and they perform facilitatory and inhibitory functions.

Sensory System—The sensory system contains the general senses and the special senses. The general senses include temperature, pain (nociception), simple touch and stereognosis. The special senses are vision, hearing, taste, smell and balance. There are many types of receptors in the body that respond each in a special way to a variety of stimuli. Some are sensitive to stimuli originating some distance away. Others are sensitive to stimuli affecting the skin, and others to stimuli originating within the body. However, perception or recognition of a sensation takes place only when the nerve impulses reach certain higher centers, such as the cerebral cortex. It follows, then, that disruption of any part of the system by disease or trauma would produce a sensory deficit.

The visual system includes the eyes, optic nerve, optic track, brain stem and the visual cortex of the cerebrum. Blindness can occur if any part of the system ceases to function properly. With the present state-of-the-art the visual system has not been replaced by electrical stimulation of any point along the visual system. People have reported "seeing" flashes of light during stimulation of the visual cortex, but meaningful patterns have not been elicited.

However, electrical stimulation has been used to enable blind people to sense the presence of objects. A large array of many small stimulating electrodes are placed on the surface of the skin, for example on the back, and activated according to the patterns produced by images from a small television camera. A person without vision is able to learn the meaning of patterns of stimulation on the skin just as a person with vision learns the meaning of visual patterns. The dimension of color, however, is lost by this method.

Failure of any of the components of the auditory system affects the ability to hear. In this case stimulation of the auditory or associated pathways and cortex elicits noise. Tests are being carried out in several centers to determine effective ways by which sounds can be modulated or processed so that the electrical stimulation of the cochlear nerve, for example, can produce meaningful information.

The sensation of smell by stimulation of the olfactory bulbs has also been reported. The suppression of vertigo by stimulation of the vestibular system has not been reported. But vertigo has been elicited during electrical stimulation of the brain stem and the cerebellum. The neurological pathways for taste are quite deep in the brain stem and they would be difficult to stimulate effectively in people, but presently there does not seem to be a need for eliciting taste by electrical stimulation.

As for the general senses, electrical stimulation at any point along the sensory system, from the skin to the cortex, has resulted in such sensations as tingling, warmth, vibrations and pain. The latter is sensed as the amplitude of the electrical pulses is increased higher than that required to elicit a tingling sensation. The sensation of pain, from a cut or abrasion of the skin for example, in the periphery is transmitted by nerve cells that are smaller in diameter than those transmitting other sensory information. As a result, electrical stimulation will initiate activity in the other sensory nerves at an amplitude lower than that required to elicit pain. Also, it has been found that some mechanism is present either in the cord or the brain stem, or both, that blocks the information in the pain pathways to the brain when a great amount of activity is present in the other sensory nerves. Hence, low amplitude stimulation of the skin, peripheral or cord nerves can block the sensation of pain from a peripheral injury.

"We should never forget that it is not the electricity as such that cures, but that it is the entire procedure of electrization with all the physical and psychic effects thereby produced."

However, the sensation or perception of pain presumably is very complex and certainly not understood. A leg could be in pain as the result of a stroke. Electrical stimulation of the nerves from the leg will not provide any benefit because the pain is being generated in the brain, probably in the higher levels of the brain stem, but not in the leg. In this example it is easy to understand why such destructive procedures as cutting of peripheral and cord nerves would be ineffective in stopping the pain. However, the idea of destroying the brain center that perceived pain aroused some interest which resulted in the development of a special procedure and instrumentation that made it posisble to selectively destroy nerve cells in the brain stem. This procedure is discussed after a quick review of the motor system.

Motor System—A special area of the cerebral cortex is the site of the nerve cells that are used to initiate voluntary motor control. Some of these cells have very long axons that descend to the spinal cord while other cortical cells terminate in the brain stem. The spinal cord is the site of the cells (motor neurons) that directly activate the skeletal muscles. Activity of these cells causes the muscles to contract or relax in response to the information that comes from the brain stem and cerebral cortex. In between the anatomical extremes of the cortical cells and the spinal motor cells is a complex array of interconnections within and among the cerebrum, cerebellum, brain stem and cord that are required to perform purposeful movements.

The proper execution of voluntary movements depends on a properly functioning involuntary system, also. For example, simply raising an arm requires complex activity of the central nervous system. In addition to the muscles that contract to raise it, other muscles (antagonists) must relax. If one is standing, then leg and trunk muscles must respond to maintain posture and balance as the raising arm shifts the center of gravity. Also, when the arm is raised to a desired position, it is expected to reach that position without hunting and to remain steady. To achieve proper limb control, information on limb position and muscle tension is sent to the spinal cord, the brain stem and the cerebellum. The information in the cord is processed to assist in the relaxing of the antagonists as other muscles are contracting (prime movers) to effect coordinated synergistic movements. The cerebellum coordinates the action of muscle groups and times their contractions so that limb movements are performed smoothly and accurately. It is understood that the signals that leave the cerebellum are primarily inhibitory and tend to provide a braking action to the motor control circuits in the brain stem. The brain stem is reciprocally connected to the cerebrum, cerebellum and spinal cord and contains many groups of cells that are extensively interconnected. Some of these groups are facilitatory in their function and others are inhibitory. Our righting and antigravity reflexes are controlled by cell groups in the brain stem. The controls for the complex coordination of muscle groups for the swallowing reflex, for eye movements and for eye focusing are found in the brain stem. In addition, the primary control of blood pressure, cardiac activity, respiration and alimentary movements originate in the brain stem.

There are many clinical signs associated with disease or damage of the motor system depending on the location and extent of the lesion. Flaccid paralysis occurs when the motor neurons in the cord or the associated peripheral nerves are damaged thereby removing all control to the muscles. Damage to motor pathways in the cord or to structures in the brain stem associated with the motor system or to the motor cortex also produces paralysis of skeletal muscles. However, in this case, the motor neurons are activating the muscles but in an uncontrolled manner, hence producing spastic paralysis. This type of paralysis of the muscles is the most common clinical characteristic of cerebral palsy. Volitional control of the muscles is difficult due to the increased tension of the muscles because of the inability of the antagonists to relax.

A common disease that is associated with degeneration of certain parts of the brain stem is Parkinson's disease. The most obvious clinical sign is the tremor, which is caused by damage to a part of the involuntary muscle control system. The tremor is more pronounced during rest than during intended movements. There is also a lack of swing in the arms during walking, which itself is difficult to initiate but once in progress also is difficult to terminate.

Disease or damage to the cerebellum produces a number of characteristic signs involving the motor system. Some examples are intention tremor, which is evident during intended movements but not present during rest; disturbances of gait and posture; and inability to stop a movement at a desired point, that is, overshooting or undershooting.

Multiple sclerosis is usually a diffuse, chronic, slowly progressive neurologic disease that degenerates the white matter of the nervous system, resulting in the breakdown of the insulating qualities of the cell's long fibers. The resulting clinical signs of course depend upon the site and extent of the disease. Some common signs are intention tremor and spastic paralysis.

Stroke, or a cerebral vascular accident, can produce many neurological disorders if not death. Common signs are pain and spastic paralysis, either together or separate.

Epilepsy is characterized by sudden, transient alterations of brain function, usually with motor or sensory involvement and often accompanied by alterations in consciousness. It is the result of abnormally active brain cells caused by injury, infection, genetic factors or unknown factors. Increased nerve cell activity in the cerebrum can produce sensation of vision, sound, smell or uncontrolled muscle activity, or a combination of these depending on the extent of the abnormal activity.

Electrical Treatment of Motor System Disorders

The most obvious, and simplest, application of electrical stimulation is to the muscles of a paralyzed limb. Healthy muscles will contract either with direct stimulation or through intact nerves that attach to the muscle. Electrodes that are placed either on the surface of the skin or implanted on the nerve can be activated appropriately to produce purposeful movements. Spastic paralysis may also be approached by this technique. As an example, some victims of stroke are left with spastic paralysis of a foot, resulting in "foot drop", an extension of the foot due to the greater strength of the extensors than of the flexors. Electrical stimulation of the nerve going to the foot flexor muscles will increase the tension in those muscles but, because of the cord interneuronal connections, also will decrease the tension in the extensors. A switch in the heel of the shoe activates the electronics at the correct part of the walking cycle.

The cerebellum, which produces an overall inhibitory effect on the motor system, is also a logical candidate for the reduction of the overactive muscles in spastic paralysis. If the output of the cerebellum could be increased, then possibly the action of the motor system could be decreased. Hence, stimulation of the cerebellum was investigated and has been successful in reducing spasticity.

Intractable epilepsy, which does not respond to medication, is another candidate for electrical stimulation of the motor inhibitory system. An epileptic attack has been described as an electrical storm of the cerebral cortex because of the characteristics of the brain waves that are recorded during a seizure. The inhibitory output of the cerebellum was found to be effective in suppressing neuronal activity in the cerebral cortex. Hence, electrical stimulation of the cerebellum is being investigated for the control of epilepsy in people.

The discovery that electrical stimulation of the spinal cord could reduce spasticity was made when a patient with intractable chronic pain was being treated with electrical stimulation of the spinal cord. This person had muscle spasticity, too, resulting from multiple sclerosis. After a few sessions of cord stimulation it was noted that the spasticity as well as the pain was reduced.

Electrical stimulation of the phrenic nerve, which is involved in our breathing process, has also been effective. The nerve is stimulated automatically to produce periodic contractions of the diaphragm. This technique gives the person freedom of movement that is not available from an iron lung.

The victim of a broken back or neck can experience not only paralysis of the skeletal muscles but also of the bladder muscles. Bladder contraction has been effected by electrical stimulation either of the cord, near where the nerves leave it to go to the bladder, or of the bladder wall muscles directly.

An area in the brain stem that has been electrically stimulated enabled a partially paralyzed arm to respond to a desired movement. That is, when the patient tried to raise his arm he was unable to until the stimulator was turned on. If he did not try to raise his arm then it remained at rest even if the stimulator was turned on. The stimulation was effective only in augmenting volitional movement in this case.

Stereotaxic Surgery

Even though certain areas or sites can be electrically stimulated to overcome certain neurological disorders, electrodes must be placed in the desired sites. In the simplest cases the electrodes are attached to peripheral nerves by relatively common surgical procedures. For placing electrodes in deep brain targets a stereotaxic surgical procedure is required. The first stereotaxic apparatus for reaching deep into the human brain was described in 1947. The stereotaxic procedure was developed for the purpose of placing a wire or small tube accurately into a desired subcortical area with minimal injury to the cerebral cortex or to the white matter. The purpose of stereotaxic surgery was to produce lesions (by thermocoagulation) or to remove or inject fluids in deep brain structures.

The apparatus in use today consists of a light, rigid metal frame that contains millimeter scales on the three axes. Skull x-rays are taken with air or x-ray opaque dye injected into the brain and with the frame mounted on the skull. The scales on the frame provide the information that is needed to compute the coordinates of the desired brain targets in terms of the frame coordinate system. A standard brain atlas provides the relative coordinates of various deep brain structures. The skull x-rays show the relationship of the patient's brain landmarks and brain size with the scales of the attached frame. Computation of the frame coordinates of desired deep brain targets are based on the standard atlas coordinates of these targets. The apparatus is designed so that the tip of the electrode, which is attached to a long, one millimeter diameter tube, is always at the center of a sphere that is scribed by the electrode holder, which is attached to the frame. The electrode holder is attached to the frame so that the center of the sphere is at the x, y, and z coordinates that are determined for a particular target.

After electrode implantation, skull x-rays are used to verify the electrode placement. A few days after implantation, with the patient awake and alert, a laboratory pulse generator is attached to the electrode wires that are protruding through the scalp. Low amplitude electrical impulses are then used to provide a physiological test of the placement. As an example, an electrode placed in a motor facilitatory area will increase the tremor in a person with Parkinson's disease. A heat lesion that is made with this electrode would result in a reduction or elimination of the tremor. For pain it was found that electrical stimulation of pain perceiving areas reduced the sensation of pain, but also that destruction of tissue reduced the pain.

Although the motor and sensory systems are anatomically separate in the brain stem there is still the possibility of undesired side effects from lesions. For example, destruction of tissue to stop tremor might also produce a sensory deficit if the electrode were too close to the sensory fibers. Similarly, the sensation of pain could be reduced by destroying tissue, but an area of the involved limb or side could be left with either a chronic tingling sensation or a numbness. These possible side effects had to be considered in early stereotaxic surgery because the effects of a lesion are irreversible. Brain cells are unique cells in that they do not reproduce; once destroyed there is no replacement.

Because electrical stimulation of the deep electrodes was used to provide a physiological test of electrode placement, records were obtained of the effects of stimulation in the human brain. However, even though the results of the stimulation may have been beneficial, no means were available to permit continued periods of stimulation over long periods of time. In order to provide a means of chronic electrical stimulation of selected targets, electronic devices had to be designed for chronic implantation.

The suppression of chronic, intractable pain was the first use of the implantable systems. Then the investigation, in animals and humans, of chronic stimulation for other purposes became more intense. Now with the implantable hardware available and further knowledge of the human nervous system the possibility of nondestructive means for reducing the clinical manifestations of neurological disorders can be realized.

Summary

The recorded use of electricity for the management of certain neurological disorders dates back almost two thousand years. Now, new applications of electrical stimulation are possible with the development of miniaturized electronic hardware and with increased understanding of the nervous system. Special characteristics of nerve cells permit their activation by electrical stimulation. In addition, the anatomical separation of the sensory and motor systems as well as separate facilitatory and inhibitory centers permit selective control of certain neurological processes. Sensory modalities can be augmented and muscle contractions can be initiated or suppressed to compensate for certain neurological disabilities. The stereotaxic procedure, which allows the placement of electrodes into selected deep brain targets, and the development of sophisticated electronic stimulating systems provide a minimal destruction of the nervous system and therefore offer new possibilities for the management of neurological disorders in people.

In their book, *Electricity in Medicine*, 1919, Jacoby and Jacoby list seven rules that should be followed when applying electricity to people. The rules point out the usual precautions that should be followed when using electricity, for example, the first rule is ". . . turn off the power before applying the electrodes". However, I think that the seventh rule is most appropriate. Perhaps it provides us with a better understanding of how electricity cures our ailments. Their seventh rule is, "We should never forget that it is not the electricity as such that cures, but that it is the entire procedure of electrization with all the physical and psychic effects thereby produced".

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Some Recent Findings in the Neurosciences and their Relevance to Christianity

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The basic building block of the vertebrate nervous system is the nerve cell. Interactions among nerve cells are accomplished by several means, chief among which are electrical pulses sent along each cell's enclosing membrane. These pulses cause the release of chemicals, called neurotransmitters, which affect neighboring cells. These neurotransmitters can influence conscious experience, as shown by the close connection between antipsychotic drugs and the neurotransmitter dopamine. As knowledge of brain function and the accompanying powers to control people accumulate, many questions are underscored. Who will control the new powers? Can the human brain be considered a computer? The answer to the last question is unknown. The organization of the brain, with its array of 10^{10} interconnected nerve cells, is far too complex for complete analysis by present methods. Moreover, it appears that a random component exists in the pulse patterns generated by all known nerve cells. Although not conclusive, this randomness suggests that any deterministic model of the brain would, in principle, be inaccurate. Thus, scientists may never be able to describe fully the reasons why a particular brain behaves as it does.

Modern scientific study of the brain is raising issues that are being taken seriously by an increasing number of people. With recent successes in measuring and manipulating various brain processes and in devising mathematical and computer models for them, brain scientists are currently gaining much deeper insights into the structures and functions of the brain. A few workers in several different areas of brain research have even concluded that enough is known about the functioning of the brain to show that it is a completely mechanistic machine.[1,2] As it is difficult to visualize how such a machine could have free will and dignity, characteristics which most Christians believe to be intrinsic attributes of a human personality, these conclusions have been strenuously resisted. Others, fearful of the growing power of scientists to manipulate the human brain, have given warnings about the possible abuse of these powers.[3,4] Thus, modern attempts to unravel the mysteries surrounding the nature of the human brain have become of considerable interest to Christianity. It is the purpose of this paper to describe a few of the newly discovered characteristics of brain function and to discuss some of their implications for Christian thought.

As in many fields of science, the study of brain mechanisms has tended to be concentrated according to various levels of complexity. Some scientists are investigating the behavior of single molecules or groups of molecules, while others investigate the structure and function of single nerve cells or of particular neural subsystems. Still others study the behavior of whole organisms. New findings in all of these areas are relevant to our purposes, but attention is focused here on the recently discovered properties of single nerve cells, particularly the mechanisms by which they communicate rapidly with each other.

BRAIN FUNCTION

The Neuron[5]

The basic building block of the vertebrate nervous system is the nerve cell, called a neuron. Neurons come in many shapes and sizes, but there are certain features common to all of them. As an example, a schematic drawing of a common neuron found in the cat's spinal cord is shown in Fig. 1. This neuron looks somewhat like a tree, with root-like dendrites, a long slender trunk callel the axon, and branch-like axon terminations. There is also a roughly spherical cell body which contains the cell nucleus and is concerned with maintaining the overall health of the cell. Attention should be drawn to the outline of the cell. The lines in Fig. 1 delineating it represent a very thin skin-like membrane which completely surrounds the neuron. This membrane, which is approximately 10^{-5} mm (10^{-8} meters) in thickness, is itself an active part of the neuron and separates the inside of the cell, with its unique properties, from its surroundings. An electrical voltage of roughly 60 mV (0.06 volts) exists across the membrane.

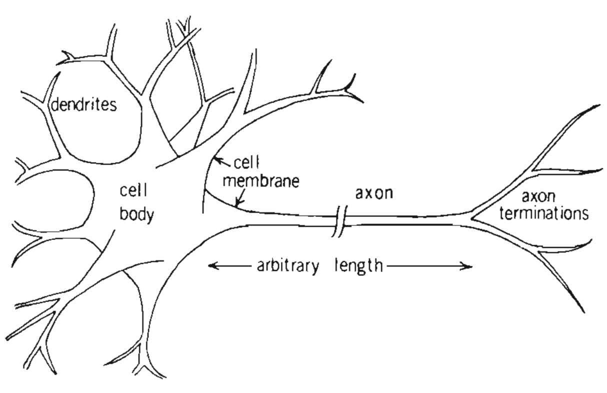

Figure 1. Schematic diagram of a representative neuron. The cell body of this type of neuron lies in the spinal cord, while the axon extends to one of the skeletal muscles, which it helps to control.

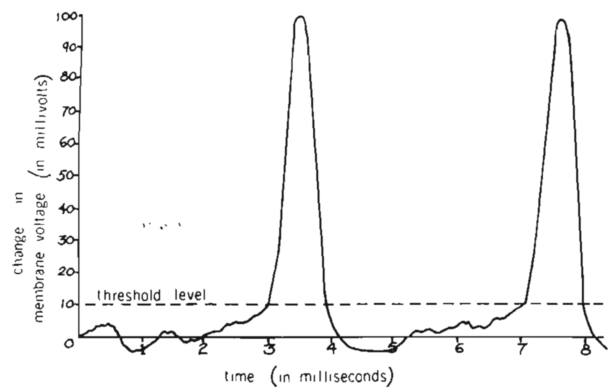

Figure 2. Sketch of the voltage across the cell membrane that might exist at the "trigger zone" of the neuron. Whenever the voltage crosses the threshold level a neuronal pulse is generated.

This may seem like a tiny voltage, but remember that it exists across a very thin membrane. At those submicroscopic dimensions, it produces quite a strong electrical effect, comparable to those in existence in modern electronic devices.

Shown in Fig. 2 is a plot of how changes in this membrane voltage might look as a function of time. For the first 2 msec (0.002 seconds) of the graph, the voltage is observed to vary rather randomly about an average value of zero. At 2 msec, a slow increase in the voltage begins so that at 3 msec the voltage has risen to 10 mV. Once the cell voltage has passed that value, a remarkable event occurs. A short voltage pulse of almost 100 mV is generated. Moreover, once the membrane has had a chance to reset itself, it will generate a similar pulse again and again, whenever this critical voltage level, called the threshold level, is crossed (e.g., at 7 msec in Fig. 2). Notice that the height and shape of the two pulses shown in the figure are almost identical. The pulse height is determined by differences in ion concentrations within and without the cell. Because these concentrations are similar for all neurons, all neuronal pulses have about the same size.

The voltage trace shown in Fig. 2 represents the voltage across a patch of membrane located near the junction of the cell body and the axon. For the type of neuron shown, this particular region has the lowest threshold level, and neuronal pulses are generated there before anywhere alse. Once generated in the junction region, the neuronal pulse has a strong influence on neighboring regions of membrane. The positive nature of the pulse raises the voltage across the adjacent patch of membrane, causing that voltage to cross its own threshold level. A neuronal pulse is then generated by this second patch of membrane and causes, in turn, the third section of membrane to generate a pulse. The first section is meanwhile resetting itself and is not affected by the pulse on the second section. The process continues on down the axon, each section generating a pulse which causes a pulse in the succeeding section. The process is very much like the burning of a firecracker fuse, where the heat of the burning section of the fuse ignites the next section. In both cases, a signal is transmitted from one end to the other, a heat pulse in one case and a voltage pulse in the other. Moreover, in both cases the length of the signal path does not matter. Once started, the pulse propagates at a constant speed to the end of the line. Unlike the firecracker fuse which burns but once, the axon resets itself in a msec or so and is ready to conduct another pulse. It will conduct many millions of pulses over the course of its lifetime. The utility of such a mechanism is clear: pulses can be sent over arbitrarily long distances without any loss of signal. Thus, although only 10^{-2} mm in diameter, the axon of the neuron depicted in Fig. 1 conducts its pulses from the cell body which lies in the spinal cord to a muscle located, let us say, in the foot, a distance of approximately one meter. There is a price paid for this "lossless" transmission of pulses over long distances. Not only does it involve an expenditure of energy to keep the axon in readiness to generate pulses, but the only type of signals that can be sent along the axon are pulses. Sub-threshold voltages, such as characterize the first 3 msec of the membrane voltage shown in Fig. 2, fade away within a few mm.

Before the neuronal pulse reaches the end of the axon, we must pause and briefly consider just how the axons terminate. Work with the electron microscope has revealed that, even to its very tip, each axon is totally surrounded by the cell membrane, but that very close, specialized connections are made with a certain number of other cells.[6] In the brain, these connections are made to other neurons, but axons leaving the brain may also make connections with muscle fibers and other types of cells. Figure 3 shows schematically a neuron-to-neuron connection, which is known as a synapse. On the left or delivering side of the synapse in Fig. 3, the cell membrane is thickened a bit and there are a number of small spherical particles known as vesicles located in the immediate vicinity. Just opposite, the membrane on the right side, which may be a patch located on a dendrite or the cell body or even in rare cases on the axon of the receiving neuron, is also thickened and presumably specially adapted for its synaptic role. Although only one synapse is shown in Fig. 3, a single axon usually makes many synaptic connections along the course of its termination.

Let us return now to the neuronal pulse as it reaches the end of the axon terminations. Just as the purpose of igniting a firecracker fuse is to deliver heat to the firecracker itself, so the purpose of the neuronal pulse is to deliver a voltage change to the membrane of the synaptic region at the end of the axon. That purpose accomplished, the neuronal pulse vanishes, without having any direct effect on the receiving neuron.

The next stage in the process is a chemical one.[7] Upon arrival of the voltage change in the synaptic region, minute packets of a chemical compound are emitted from the axon into the gap between the two neurons. Although not absolutely certain, there is strong evidence that the total contents of one of the spherical vesicles clustered in the synaptic region make up one packet. Upon arrival in the narrow synaptic cleft, the molecules of the chemical compound are bounced around by other molecules and quickly arrive at the membrane of the receiving neuron. There, the emitted molecules form linkages with special sites on the receiving membrane that are very precisely constructed for the reception of that type of molecule. After a brief linkage, the emitted molecules break free and most of them, by various processes, are absorbed back into the emitting neuron for recycling.

During its brief existence, the linkage between the receptor site and the emitted molecule causes a change to occur in the properties of the receiving neuron's membrane. This structural change in turn causes a small voltage change to appear in the receiving neuron. If enough emitted molecules link up with the receiving membrane in a short time, the sum of all their voltage changes might be enough to carry the voltage of the trigger zone of the receiving cell past the threshold level, and a neuronal pulse would be generated on the axon of the receiving cell.[8] Thus, through the use of a chemical intermediate, a voltage change is produced in the receiving neuron by the neuronal pulse on the emitting axon. As a recognition of its message-carrying nature, the chemical used as the intermediate is known as a neurotransmitter.

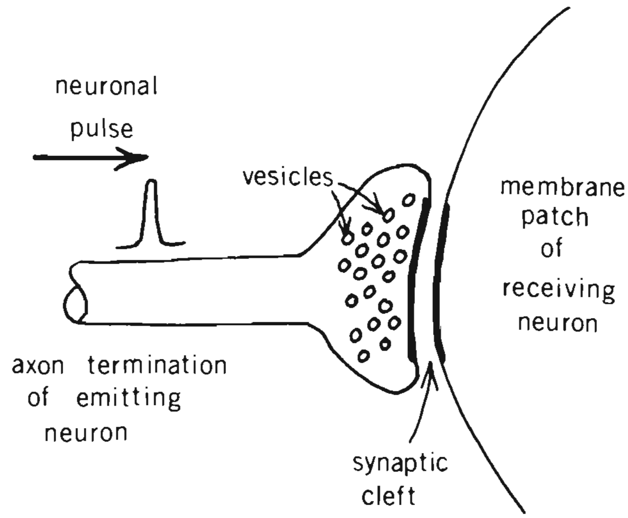

Figure 3. Schematic diagram of a synapse. The arrival of the neuronal pulse at the axon termination causes the release of chemicals thought to be stored in the vesicles. The synaptic cleft is about 2 x 10^{-5} millimeters wide.

Not all of the interactions between neurons are carried on by means of nerve pulses, the only known method of rapid interneuron communication over long distances. Other modes are used when neurons lie near each other. For example, dendrites of neighboring neurons may form close contacts having all of the signs of chemical transmission: vesicles localized in one dendrite and thickened cell membranes existing on both sides of the synaptic cleft.[9] Thus, the transmission of information between these dendrites appears to be by means of neurotransmitters. In this case, however, the release of the chemical is not necessarily triggered by a neural impulse, but may be released by the smaller sub-threshold voltages that exist across the cell membrane in that region. It has been estimated that up to 50% of the brain may be composed of locally interacting circuits,[10] where transmitter release is governed by these sub-threshold cell potentials and by neural pulses conducted on very short axons. There is evidence that some of these neighborhood interactions may even be by direct electrical means, without the use of chemical transmitters.[11]

A Neurotransmitter

Some of the most exciting recent discoveries in the neural sciences have been concerned with neurotransmitters.[7] The use of the plural form of the word is deliberate, for it is well established that not all neurons use the same neurotransmitter chemical. Two compounds, acetylcholine and noradrenaline, have been positively identified as neurotransmitters. That is, both compounds possess the complete set of specific characteristics that neurochemists have established as essential for a neurotransmitter. Nine other compounds present in the brain have been identified as possible neurotransmitters, but as yet they have not been shown to possess all of the needed properties. Although each of these compounds merits extensive discussion, we will consider only dopamine, one of the nine partially proven neurotransmitters. Effects attributed to its presence are very impressive and are closely tied into conscious human experience.

Dopamine seems to serve several purposes in the brain. Its clearest role is in connection with the proper functioning of the muscular nervous system. Not long ago, it was discovered that the brains of some patients who had died of Parkinsonism, a disease which produces uncontrollable shaking in its victims, had an abnormal dopamine content. In these brains, a particular region that is normally rich in dopamine, due to dopamine-containing axons which terminate there, was found to have virtually no dopamine. In attempts to supply the missing dopamine, it was further discovered that injecting a closely related compound, dopa, into the blood of Parkinson's disease patients, dramatically helped to relieve their symptoms. Apparently, the dopa molecules had been able to cross into the brain, and there they had been changed into the needed dopamine by a brain enzyme known to promote this transformation. Thus, although the precise roles of dopamine-releasing axons in the neural circuits involving muscular control are unknown at present, it seems clear that these roles are of major importance.

The excellent correlation of the data is indeed strong evidence that the powerful therapeutic effect of the antipsychotic drugs is related to the reduction of the flow of dopamine between neurons.

Another role for dopamine is in the process of being established. Since their initial appearance in the 1950's, there have been a number of drugs developed for the treatment of schizophrenia. Many of these drugs are quite different from each other, but all have antipsy-

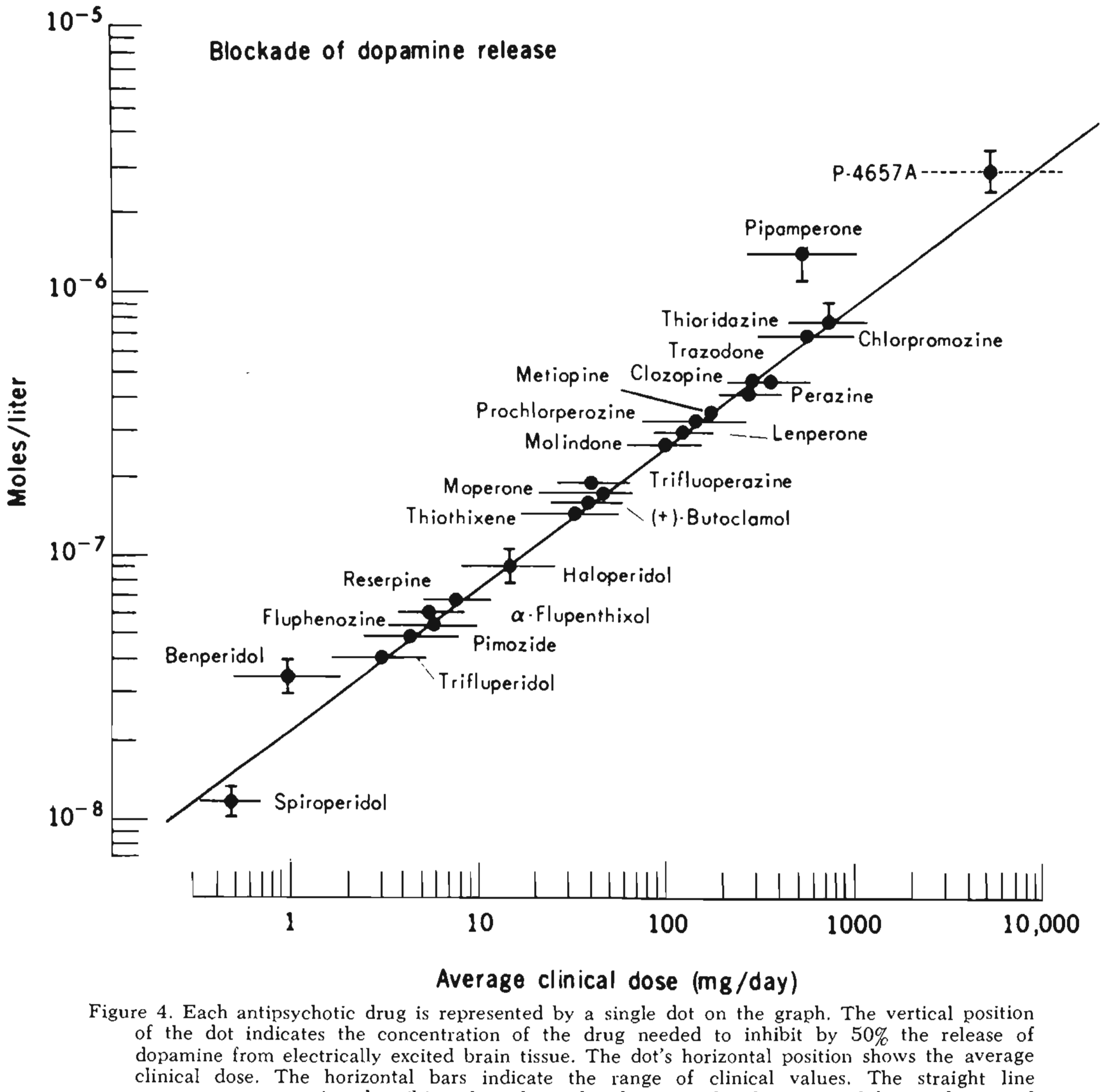

Figure 4. Each antipsychotic drug is represented by a single dot on the graph. The vertical position of the dot indicates the concentration of the drug needed to inhibit by 50% the release of dopamine from electrically excited brain tissue. The dot's horizontal position shows the average clinical dose. The horizontal bars indicate the range of clinical values. The straight line represents an equation describing the relationship between the dopamine-inhibiting doses and the clinical doses. Reprinted with permission of the authors and *Science* from Ref. 13, copyright 1975 by the American Association for the Advancement of Science.

chotic effects. Research involving these drugs has shown that they also have in common the ability to block the transmission of dopamine between neurons. Although the precise mechanisms of this blockage are still in debate,[12,13] there is evidence which suggests that the drugs inhibit the release of the dopamine from the ends of the emitting axons. Figure 4, a drawing taken directly from a recent report, [13] shows the doses of the different antipsychotic drugs needed to reduce by 50% the amount of dopamine released by electrical stimulation of excised brain slices, compared to the average clinical doses used for controlling schizophrenia. The correlation between the two measures is really remarkable. Although the different clinical doses vary by more than 10,0000-to-1, they can be used to predict with extreme accuracy the dopamine-inhibiting effect. It can be seen, for example, that quite high doses of chlorpromazine are prescribed for controlling schizophrenia, and that quite high doses of that drug are also needed to inhibit the release of dopamine from brain slices. Only the few points at the extreme top and bottom of the figure deviate significantly from the relationship shown by the straight line. Although the brains of rats, from which the electrically excited samples were obtained, are obviously very different from human brains, they have many biochemical similarities. Thus, the excellent correlation of the data in Fig. 4 is indeed strong evidence that the powerful therapeutic effect of the antipsychotic drugs is related to the reduction of the flow of dopamine between neurons. However, even if this particular relationship were to be confirmed, much would remain mysterious. For example, it is not even clear which of the several kinds of dopamine-containing neurons are involved in the tranquilizing reactions evoked by the antipsychotic drugs. More fundamentally, the relationships which exist between neural activity and conscious experience of any kind are almost completely unknown.

Neuronal Pulses

For the last two decades, neuronal pulses have been directly observable by means of microelectrodes. These devices, which in principle amount to small wires sharpened to a very fine point, have minute tips that can be positioned either just inside or just outside a single neuron. With that positioning, each pulse generated by that neuron causes a very small electrical signal to flow through the microelectrode. Electronic amplifiers increase the size of the signals up to the level needed by the pulse analyzing equipment used, principally the computer. This combination of the microelectrode to record neuronal signals and the computer to analyze them has been a very productive one. Using them, brain scientists have been able to investigate pulse patterns generated by neurons in many different regions of the brain. As an example of the kind of information being gathered, let us consider the pattern of pulses which has been recorded from neurons of the ear. These patterns are among the simplest in the vertebrate nervous system, and extensive studies have revealed the main outlines of their behavior.[14]

There are approximately 50,000 neurons that send information from each ear into the brain of the cat, a common experimental animal. These neurons have cell

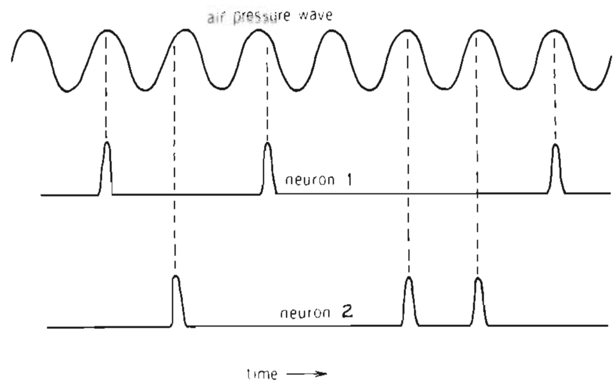

Figure 5. Sketch of the waveform of the air pressure caused by a musical tone as well as the neuronal pulse trains that might exist on two of the thousands of axons extending from the ear into the brain. The statistical properties of the two pulse trains are identical.

bodies and single dendrites situated in the bony parts of the ear, and their axons extend to just inside the brain of the animal. The obvious purpose of these neurons is to carry information into the brain concerning the sound signals striking the ear. Figure 5 shows an example of how these neurons respond when a pure tone, say middle C, is sounded in the ear. The top line of the figure shows the waveform of the air pressure changes caused by the tone, and the middle line shows the neuronal pulse pattern that would typically be observed on a single one of the axons leading into the brain. At first glance, the pattern is not impressive. There are relatively few pulses and they seem to occur rather randomly. Sometimes a long interval separates two adjacent pulses and sometimes they occur in quick succession. On further investigation, however, it is found that there is a great deal of orderliness in the pattern. Either a single pulse or none at all is generated during any one cycle of the sound stimulus. Moreover, if a pulse does occur during a particular cycle, its time of occurrence is restricted to that part of the cycle near the pressure peak. A study of the intervals between pulses would reveal that although the sequence of long and short intervals is unpredictable, the probable numbers of short ones and long ones that will occur in the future can be estimated from the corresponding numbers in these data.

It might be wondered at this stage just how the brain could make sense of such a signal. If the pulse patterns of neuron 1 were the only information that the brain received about the sound signal, its interpretation would indeed be difficult. Remember, however, that thousands of these axons exist. Many of them are known to produce pulse patterns that, although not identical to the pattern of neuron 1, have nearly the same general description. Thus, the second pulse pattern shown in Fig. 5 shares all of the characteristics given for the pattern of pulses generated by neuron 1, but the two patterns are not identical. Imagine summing 100 such pulse patterns. On any one particular pressure peak, some neurons, say 20 on the average, would generate a pulse; few neurons would generate a pulse in any of the pressure valleys. Thus, every time about 20 pulses occurred within a short time period, a pressure peak would most probably have occurred. If only one or two pulses occurred in that period, a pressure valley most likely occurred then. Simply observing how the total number of pulses occurring on those 100 axons varied with time would give the observer a rather accurate indication of the pressure waveform.

The uncertainty concerning just when a neuron is going to generate the next pulse is not confined to the neurons leading from the ear. All neurons which respond to tones, even those located in the brain's farthest reaches[15], do so by generating pulse patterns which contain a considerable measure of uncertainty. It seems clear from this neuronal variability that the same tone will be represented differently in the brain at different times. Data showing unpredictable aspects could also be presented for the responses produced by other types of sensory stimuli. Neurons in the brain responding to flashes of light generate different pulse trains in response to identical repetitions of the same flash.[16] Moreover, uncertainties are not confined to the sensory systems of the brain. Neurons such as that depicted in Fig. 1, which send pulses out of the spinal cord to control the muscles of the body also display variability in their discharge patterns, although those pulse patterns are much more nearly predictable than the ones shown in Fig. 5. In general, it appears that all neurons have some degree of unpredictability connected with the generation of their axon pulses.

The Neuron as a Computing Element

Some of the information-transferring functions of the single neuron are now fairly well understood, at least in general principles. Although the details of the generation of the nerve pulses and the release of chemical transmitters by the different kinds of neurons are not yet known, there is no longer any real disagreement about the reality of these basic neuronal processes themselves. One neuron does not, however, make a brain. It takes many of them working together to make up the simplest kind of brain. It is this very area of interconnections and interactions between neurons that brain scientists are now just beginning to investigate.[9] Unfortunately, the research is so new and the complexities of the brain so great that not much can be said yet of a positive nature. Although a considerable amount is known about where the axons of individual neurons begin and end and about which parts of the brain are related to which functions, the particular interactions between neurons by which the brain processes and stores the vast amount of information it receives are almost wholly unknown. In view of this ignorance, it is clearly impossible to state whether or not the brain is constructed like a digital computer, or anything else for that matter. However, because of the similarities in their overall information processing abilities, the brain and the digital computer have been considered by some to be the same type of mechanism.[2] To appreciate just how computer processes might be considered models of brain processes, it will be useful at this point to compare certain aspects of the two systems.

The basic building blocks of the digital computer are called logic elements. Each of these elements is an electronic device that has a single output terminal which can have only one of two possible voltage levels on it. If the sum of the input voltage is more positive than a certain threshold level, say for convenience 10 mV, the output is set to one level, say 100 mV. When the input voltage is below the threshold level, the output voltage assumes its other level, say zero volts. Thus, the output level of the device is either zero or 100 mV, and the particular level which exists at any one time depends on whether or not the input voltage exceeds the threshold level, 10 mV. Aside from the fact that its output voltage level does not automatically reset itself to zero upon reaching the 100 mV level, a property which could be easily added, the behavior of the logic element is strikingly reminiscent of the neuron membrane (cf. Fig. 2). This resemblance is no accident, for the first logic element was in fact developed as a model for a patch of neuron membrane.[17] The communication of one element with another is also similar to the communication between neurons. Although no chemical intermediates are involved, the output of one logic element is conveyed via wires to the inputs of other elements, where it causes voltage changes to appear.

The wonder is that the brain is able to achieve such highly reliable results with basic building blocks whose characteristics are describable only in probabilistic terms.

There are differences, however, which do exist between the neuron and the logic element. For one, the particular way in which these input voltage levels are handled by a modern digital computer's logic elements is different from the way in which neurons handle incoming pulses. To put it simply, a logic element generates pulses on its output lines in response to single input pulses, whereas the neuron generally needs many pulses before it can produce a pulse. But this difference should not be considered an essential one, for it is possible to build computers from a different type of logic element, one which, like a neuron, requires the summation of many input pulses before an output pulse is generated. In fact this summing type of logic element is a more powerful computing element than the type operating by means of single pulses.[18]

There is a second and apparently more fundamental difference that exists between the neuron and any type of logic element now in use. On the one hand, the logic element is a completely deterministic device that, if working properly, always generates an output pulse when the proper input pulse or pulses have been received. Any uncertainty in the timing or size of the pulses is considered a cause for concern and steps are taken to make these uncertainties as small as possible. On the other hand, uncertainty seems to be a basic property of a neuron. Consider, for example, the situation shown in Fig. 5. It is impossible to predict, by any known methods, whether neuron 1 will emit an output pulse during any particular cycle of the sound wave. It cannot be argued that this uncertainty is simply a matter of particularly unfavorable conditions. For no matter how loud or soft the sound is made, the pattern of output pulses can still be described only in probabilities and not certainties. Furthermore, as was already pointed out, these uncertainties are not con-

Present scientific evidence does not prove or disprove the existence of the soul nor prove or disprove that humans are only biological machines.

fined to neurons handling sound information, but are characteristic, to some extent, of all neurons studied. It should therefore come as no surprise to learn that most of the mathematical descriptions of neural pulse trains use statistical and probabilistic methods.[19]

As so little is known about detailed interneuronal functioning, it is exceedingly difficult to try to contrast the operation of the brain at any level of organization other than that of the basic building blocks. It would appear, however, based on the differing characteristics of their basic building blocks, that the brain and the computer will prove to be very different. The modern digital computer is a completely deterministic machine, dependent for proper functioning on the unfailing operation of every single electronic component. By contrast, the brain can apparently tolerate considerable variability in the response characteristics of all of its neurons. Moreover, experiments have failed to show that the brain is dependent in its operations on any one neuron.[20] The wonder is that the brain is able to achieve such highly reliable results with basic building blocks whose characteristics are describable only in probabilistic terms.

IMPLICATIONS FOR CHRISTIANS

Lessons describing the characteristics of single neurons or chemical transmitters are not scheduled for inclusion in the educational curricula of the Christian Church. Yet modern scientific study of the brain is of importance to Christians because of the intimate relationship which exists between the brain and the mind. ("Brain" is here used to mean the physical organ. "Mind" is used in the psychological sense to mean "the totality of conscious and unconscious mental processes and activities"[21] of a person.) For it cannot be denied that altering and controlling the human brain has proven capable of altering the most intimate and personal aspects of human experience.[7] The use of antipsychotic drugs to control schizophrenia is but one example of the many ways in which drugs can be used to change fundamental aspects of human personality. There are also electrical[22] and surgical[23] means of altering the brain which greatly change human experience. In short, in its rapid development of ways in which to exert direct control over the brain, the neurosciences are also learning to control the human mind.

Ethical Implications

Many of the practical implications for Christians, and for other ethically minded people, of the new types of biomedical control have been clearly stated by others and do not need to be completely restated here.[24] However, it would be well to consider briefly one area of ethical concern which has particular relevance to brain research. This area concerns questions on the use and abuse of power.

Perhaps the most important point to be raised regarding the exercise of the new powers that neuroscience is creating is the one raised many years ago by C. S. Lewis.[3,4] In eloquent language, he pointed out that the powers created by science are never wielded by humanity as a whole, but by the small minority of people who happen to be in control at the time. It must be granted that so far, in this country, the powers of brain control have been used mostly for beneficial purposes, such as controlling schizophrenia and relieving the symptoms of Parkinson's disease. Indeed, it is with the long range hope of learning how to prevent and alleviate diseases and malfunctions of the brain that the large amount of federal support for brain research is granted. Yet, regardless of original motives, new powers of control are being created, and once created, these powers will be available to future controllers, whoever they may be.

As an example of the possible mischief that could be accomplished, consider the method recently suggested by two brain scientists for the control of violent crimes. Under this method, parolees, high risk ex-convicts, and people on bail would be required to wear physiological monitoring equipment connected by tiny two-way radios to a computer.[25] The computer's programs would continually monitor the signals telemetered to it by each radio. Whenever the programs detected an excited physiological state in a subject located in a suspicious place, an impending crime would be diagnosed. Police would be dispatched to the scene or an electrical shock would be applied to certain of the subject's brain centers, causing him to forget or abandon the project. Such a system is technically feasible now, but would be of little or no value, because only the crudest of estimates of the state of mind of a person can currently be constructed from physiological data, including brain signals. Even so, the subject, with constant surveillance of both his external and internal worlds and with the continual threat of instantaneous outside intervention, would suffer a much more profound loss of privacy and free will than in prison. These potential losses will no doubt become greater as the years go by, for brain scientists will be able to make increasingly accurate judgments about a subject's mental state and be able to influence it more exactly. Some may argue that though regrettable, such effects would be tolerable, for they would be confined to a small criminal segment of the population. However, history, including that of some countries during this very year, teaches us that anyone, irrespective of his actual offenses, can be declared a lawbreaker by the powerful. Moreover, many governments have demonstrated that the number of oppressed need not be a small number nor only a small segment of the population. Science is forging unique tools of great power. To believe that these tools may not someday be used ruthlessly against powerless people is to ignore the lessons of history. It is also to ignore the Biblical lesson that the kingdom of God is not yet established on the earth,[26] and that evil still exists.

There are several other ethical aspects of brain research that have been raised[24] that must be at least mentioned here. On the one hand, it is possible that some people without outside coercion will voluntarily use the fruits of brain research for self-degradation and dehumanization. The contemporary drug culture has graphically pointed out just how far this process can go. On the other hand, much of the truly beneficial knowledge that is being developed will, for a long time to come, be readily available only to those limited segments of our country's and the world's populations that are able to obtain adequate medical care. Like all inequities, this distribution presents serious ethical problems. Taken together, all of these concerns indicate that further brain studies should be approached with great caution. It will require great wisdom to plan future research so as to obtain the maximum of beneficial results and at the same time to develop adequate safeguards against the misuse of the resulting powers. Christians, with the fear of the Lord which is the beginning of wisdom,[27] have important roles to play in this planning.

Theological Implications

The increasing ability of brain scientists to understand and manipulate the human brain and mind by using the techniques of the physical sciences has goaded some people to the belief that the brain must operate totally according to the same basic physical and chemical priciples that govern inanimate objects.[1,2] Implicit in this belief is a conviction that the mind is some aspect of the brain's functioning, with no existence apart from the brain. For it is without question that the brain controls the muscles of speaking and acting (cf. Fig. 1). If the brain's activities, and hence the person's words and deeds, were to be totally explainable by physical and chemical principles, then neither the brain itself nor anything acting on it would be exempt from following these principles. In short, the mind would have to be a manifestation of the activity of the brain, totally explainable by scientific principles, or it would have to be a totally passive spectator.

Although mechanistic interpretations of human behavior are not new,[28] there now seems to be fresh evidence to support these positions. What should we think of such hypotheses? Is a belief that the brain and the mind are just parts of a biological machine compatible with Christian beliefs?

Most Christians through the centuries have answered the last question with a resounding, "No". They believed that the essence of every person is a non-material immortal soul. Orthodox Christians still believe that the soul goes immediately to its reward upon the death of the body. There, they believe, the soul will remain, independent of a body, until it is joined to a new and different kind of body at the final resurrection.[29]

It should be clear by this point in the paper that scientific evidence is not capable of deciding this basic disagreement between most Christians and the mechanists. The human brain's array of more than 10^{10} neurons, interconnected by means of neuronal pulses and other mechanisms, is of a complexity far beyond the ability of modern science to analyze and describe completely. The point was well summed up by Dr. H. Davis, a distinguished senior neurophysiologist. At a recent meeting of the Society for Neuroscience, he referred to the relationship between the brain and the mind as the neurosciences' toughest unsolved problem.[30] He further states that neuroscientists have learned not even to use physiological and psychological terms in the same sentence, because of the mysterious gap that exists between them. Some scientists even go so far as to say that the scientific tools needed to tackle that gap have not even been developed yet.[20] In short, understanding of the neural principles governing the brain's "higher" functions, with which the soul and the mind are associated, is much too rudimentary in nature either to support or to attack the traditional Christian position at this time. The first conclusion to be reached, therefore, is that present scientific evidence does not prove or disprove the existence of the soul nor prove or disprove that humans are only biological machines.

As brain research continues, however, knowledge of the workings of the brain will undoubtedly continue to grow. Increasingly complex models of neurons and neuronal interactions will be developed and some would see no barriers to eventually achieving arbitrarily detailed explanations of the brain. If that happened, there would be no need to talk about the soul, for all human actions would be predictable by scientific principles. It appears, however, that there may be naturally imposed limits to the ability of science to describe brain behavior. As we have seen, the present study of neurons has indicated that the uncertainties connected with the times of occurrence of the neuronal pulses are beyond current deterministic explanation. Thus, even if future scientific advances would make it possible to construct mechanistic models of each neuron in a particular brain and of all of their interconnections, it would seem unlikely that the actions of the brain model would be exactly those of the brain itself. For, as far as we can see now, the model of each neuron and perhaps each neural conection would have to include elements of uncertainty. Some models of the neurons represent these uncertainties by means of random variations in the threshold voltage level.[31] Others include uncertainties in the times at which the packets of chemical transmitters are discharged into the synaptic cleft.[32] By these and other means, most neuron models now incorporate an element of random behavior.[19]

Ever since the inception of quantum theory, scientists have suggested that the uncertainties of position and movement assigned by the theory to elementary particles might be important in the functioning of the brain.[33] As these uncertainties on the atomic scale are very small, various schemes have been suggested for amplifying their size[33] so as to produce effects at higher levels of organization. It would appear that the neuron is just such an amplification device. For, if the neuron models are accurate, uncertainties in the threshold level or in the times of transmitter release are events caused by uncertainties in the motion of a relatively few atoms and molecules. The unpredictabilities of these few particles would thus be reflected in the uncertain timing of the neuronal pulse, an event which controls the flow of many thousands of atoms and molecules. In any case, uncertainties, originally thought to hold only for atomic and molecular events, appear to be a fundamental characteristic of pulse events occurring in the neuron. And as the neuron is the basic building block of the brain, uncertainty is thereby introduced into the highest levels of its organization.

Science may never be able to decide whether or not human beings have free will or a soul.

A word of caution must be inserted here. The uncertainties observed in neural behavior might possibly be removed by future studies. One possibility is that investigations pushed to molecular levels of organization might yield deterministic descriptions of the emission of neurotransmitters by the vesicles. This particular eventuality seems very unlikely, for current investigations show that the times of neurotransmitter packet release do indeed seem to have random distributions.[34] Another possibility is that groups of neurons may be found which together have deterministic behavior. A logic element is an example of such a device. Its deterministic electrical output is made up of many electrons and other charge carriers, each of which can be described only in probabilistic terms. So far, however, there is no evidence of any groupings of neurons which produce completely deterministic outputs. Thus it would appear that some degree of uncertainty is indeed a fundamental characteristic of the triggering of neuronal pulses.

The theological implications of uncertainties in the functioning of individual neurons are unclear. Some have argued that unpredictable events in the brain would reduce the control that an individual has over his own thoughts and actions.[35] Others feel that uncertainty connected with brain events would provide a mechanism for free will to act that would not disturb the predictability of physical events.[33] Under this scheme, the will would be able to alter the individual brain events which happened at particular instants without changing the statistical properties of the events, which would be under the control of physical principles. Whatever the merits of these speculations, the existence of fundamental uncertainties in the timing of neuronal events would mean, subject to the qualifications given in the preceding paragraph, that science would never be able to construct a completely deterministic explanation of the functioning of the brain. The uncertainties in this explanation could very well be large enough to produce uncertainties in the basic decision-making processes of the brain, processes commonly associated with the will and the soul. Thus, a second conclusion can be drawn: science may never be able to decide whether or not human beings have free will or, by implication, a soul. In any case, the decision is a very long way off.

It would be irreverent to end this section and this paper without reporting the feeling of awe and wonder that often steals over neuroscientists as we contemplate the workings of the brain. Everything is so complex, yet, when understood, all of the parts prove to be beautifully fitted for the functions that they fulfill. Surely we are fearfully and wonderfully made.[36]

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What Is Man?--A Biological Perspective and Christian Assessment

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"We are nature's unique experiment to make the rational intelligence prove itself sounder than the reflex. Knowledge is our destiny. Self-knowledge, at last bringing together the experience of the arts and the explanations of science, waits ahead of us."[1]

"Man is a machine by birth but a self by experience. And the special character of the self lies in its experience not of nature but of others."[2]

"Man knows enough but is not yet wise enough to make Man."[3]

"When Aristotle marked off man from the rest of the animal world by what he called 'rationality', or when a modern anthropologist turns to tool-making or cave-painting or burial of the dead as clues to the presence of man, they are singling out some of the many ways in which the human ambition to understand the universe manifests itself. But the understanding of understanding is no simple matter."[4]

Introduction

It is evident from the above quotations that any attempt to answer the question 'What is man?' in a narrow biological fashion is doomed to failure. As a biologist I will of course lay emphasis on the biological aspects of man's existence, but neat, rigidly-circumscribed biological answers cannot suffice. This is because, in dealing with man we are not dealing with some isolated entity far removed from our own experience. In looking at man, we are looking at ourselves. In asking questions about man we are asking questions about the one who asks the questions. It should not surprise us therefore, to learn that the dividing line between biological answers and philosophical or theological ones can become very ill-defined.

In spite of these provisos however, the question is a legitimate one for a biologist to tackle. Whatever else man is, he is a biological phenomenon. He is part and parcel of the biological world, he possesses all the attributes of a living species, and he is subject to many of the rules and regulations imposed upon living things by the environment. But of course he also appears to be more than this. He is not *completely* dominated by the environment; he has a control over it and himself that marks him off from the remainder of living beings. And this is where the limitations of a purely biological approach to man become evident. This is no man's land, and this is where biology takes on distinct philosophical overtones.

But to return to our question: 'What is man?' J. Z. Young[5] has paraphrased this to read: 'What are good ways to study men?', and he begins his mammoth task, enshrined in his book *An Introduction to the Study of Man*, by asking: 'What are men made of?' This approach epitomizes that of the biologist with its reductionist overtones, although Young makes a valiant attempt to put the pieces together again and so emerge with a coherent picture of man. The biologist, however, is frequently accused of downgrading man in his attempt to reduce him to managable terms,[6] and this is certainly a valid criticism on occasions. Man may be a 'naked ape',[7] but is he nothing more than a naked ape? Man may be a tool-maker, but is this his only attribute? It may be useful to compare man to a machine, but is it valid to conclude that he *is* a machine and that this compels us to relinquish all claims to human uniqueness?[8]

It would be instructive to compare the relative frequency with which biologists ask the question 'what is man?', and the relative infrequency with which they attempt to answer it. Perhaps they are wise; perhaps the attempt alone is the height of folly; perhaps a simple answer must in the nature of things be a misleading one. In spite of such warnings I will attempt to give a biological answer to the question, even if it is far-from-simple and even if, by the end, it is a little way removed from biology.

Definitions of Man

The definitions of man put forward by human biologists fall into two main categories: a) those based on evolutionary data and emphasizing man's distinctiveness compared with other primates, and b) those illustrating the attributes of man's brain and hence his capacity for conceptual thought, the culture he has constructed as a consequence of this and his search for meaning and purpose. Both categories are essential for a holistic view of man, and I intend taking both into account.

However, before looking at these in detail it would be interesting to savour the range of definitions put forward by various authorities, in an effort to get a feel of the possibility open to us.

> Modern man is one of the most successful mammals that ever lived, successful entirely because of the development of cultural behaviour.[9]
>
> Man is the sole product of evolution who has achieved the knowledge that he came into this universe out of animality by means of evolution.[10]
>
> Man is a tool-making animal; or alternatively a cooking animal.[11]
>
> Man is a technological animal, and technological change is the fundamental factor in human evolution.[12]
>
> Man is nothing else than evolution becoming conscious of itself.[13]
>
> Man is aware or conscious of his self; he has a mind, an ego and a superego; he is capable of insight, abstraction, symbol formation, symbolic thinking, and of using symbolic language.[14]
>
> Man learns and teaches more than any other creature and therefore has the greatest possibility and opportunity to direct the course of events in the world. It is his nature and his biological function or duty to do so.[15]
>
> Man is the animal who relinquishes nothing. He simply adds to what he already is and has.[16]
>
> Man is a being who asks questions concerning himself.[17]

Distinguishing Features of Man

Under this heading I want to discuss the features which characterize modern man in the eyes of the physical anthropologist. These features will of course be confined to osteological characteristics because it is these which constitute the basis of the fossil record.

Before discussing these features however, we need to define what we mean by the term 'man'. As I have already hinted I am principally thinking in terms of modern man, that is present-day man, or as the anthropoligists would call him *Homo sapiens sapiens*. The term *Homo sapiens* is generally used to refer to archaic man who was distributed throughout most of the Old World and consisted of a number of populations in different geographical locations. The best known example of archaic man is Neanderthal man who lived in Western Europe during the last ice age. Archaic man had appeared by 250,000 years ago, he had a large brain and differed from modern man mainly in the form of the skull which was long, low and broad with a big face surmounted by a massive brow ridge.[18] Archaic man, while differing in a number of skeletal and cultural respects from modern man, is of course more closely related to modern man than to examples of early hominoids such as *Homo erectus*. For the purposes of the present discussion I will confine my attention to the species *Homo sapiens*, and in later sections will concentrate on the subspecies *Homo sapiens sapiens*. I will use the term *man* to refer to *Homo sapiens* in general.

The unique adaptive features of man detectable in the fossil record can be classified under three headings: the postcranial skeleton, the dental apparatus and the brain. For clarity I will subdivide the post-cranial skeleton discussion into three parts: the hands, toolmaking and tool-using, and upright posture.

The Hand

The hand and forelimb in man have been relieved of their locomotor functions and have instead become specialized for the handling and manipulation of small objects. What this means in structural terms is that the fingers are relatively short while the thumb is relatively long and, of even greater importance, is capable of being rotated so that the tip of the thumb is brought into contact with the tips of the other fingers. This latter movement is known as *opposition* of the thumb, and whereas apes are capable of some opposition the precision of this action in man and the ability to oppose the thumb and forefinger are unique human characteristics.

The human hand is superbly adapted for fine movements, as is clearly demonstrated by the opposability of the thumb, the presence of nails rather than claws, and the arrangement of the intrinsic muscles of the hand. These features enable man to use a precision grip as well as a power grip in manipulating small objects, which in evolutionary terms meant tools. Other structural features essential if man was to make full use of his hands was great mobility at the shoulder and elbow joints and adequate development of those parts of the brain (motor cortex and cerebellum) essential for the fine control of hand movements.

Tool-making and Tool-using

Possessing hands with this range of functional potential enabled archaic man to use and later make *tools*. The significance of this step cannot be overemphasized as it was the first sign that man was breaking free of the bondage of his environment. Not only this, it also signalled the onset of the *artificial* in man's life. No longer would man have to rely on anatomical attributes alone, he could now devise substitutes for hands and brute force. Indeed it is not too much to argue that the era of *inventiveness* had arrived.

The very earliest tools date from 2.5 million years ago and probably were being manufactured even before this [19]. Clearly they belong to some of the earliest examples of hominid development, and while chimpanzees are capable of tool use, human tool use serves a variety of functions rather than a single function as in other primates. The very earliest tools appear to have consisted of very crude pebbles chipped along one edge. These chopper tools associated with *Australopithecus* were slowly improved by two-way chipping of the edges. Much later came the hand-axe at the time of *Homo erectus*, and this underwent continual improvement to produce the more sophisticated and more extensively chipped hand-axe in vogue with Neanderthal man, that is, early *Homo sapiens*. Tools underwent a major revolution with the appearance of *Homo sapiens sapiens*, perhaps some 35,000 years ago, with the development of very thin, sharp blades that could be used for a variety of purposes from cutting to chiselling.[20] For here it is a relatively short step to the immense variety of instrument types with which we are familiar.

Important as are tools in the road to modern man it would be misleading to consider their development in isolation from other, closely-related events. The early stone tools implied *hunting*, which in turn implied cooperation between individuals and the emergence of a nascent form of *social life*. Integral to both these developments was the existence of a system of *language*, and hence a brain capable of nurturing speech. The inter-relationship of these traits appears essential, although the order of their appearance and the causal factors involved in their development are matters for speculation.

Tool-making assumes significance within the context of these interrelated events. Pilbeam expresses the point thus:

> From this point on, hominids were cultural animals, imposing arbitrariness on the environment, thereby making it more complex, increasing the richness of sensory input, and further selecting brains that were more effective processing organs".[21]

Upright Posture

Man is characterized not simply by his upright posture, as other primates are capable of bipedalism under certain circumstances, but by his *habitual upright bipedalism*. It is self-evident that this is essential for full use of the hands, freeing them for manipulation and hence modification of the environment. The demands of habitual bipedalism on the muskulo-skeletal system are enormous and do not concern us here, while bipedal walking also requires complex control by the nervous system.

Suffice it to say that the lower limb has undergone rotation, fitting it for increased weight bearing and mobility. In addition the human vertebral column has developed a series of curves, and the position of the centre of gravity of the body is such as to ensure a minimum energy expenditure during standing.

The Brain

While the amount of information available on brain structure from fossils and bones is limited, some important principles do emerge. The human brain is approximately three times as large as that of nonhuman primates, modern man having an average brain volume around 1400 cm^3, and that of the gorilla 500 $cm.^3$ More significant than actual volume increase is the fact that the cerebral hemispheres are considerably expanded in man, and are deeply infolded, with certain areas within the cerebral cortex being particularly well-developed. In addition to these features, the branching of the nerve cells within the brain and the connections between nerve cells contribute to a level of internal organization and interrelationship that result in uniquely human features.[22]

Man can be described fairly fully in purely biological terms, but he also insists on presenting himself to us as a being of value, as a person continually asking questions and continually searching for meaning in his life.

This idea that the organization of the human brain, rather than simple brain volume, constitutes characteristics that are essentially human is clearly demonstrated in human *microcephalics*. Although such people may have a brain volume within the range of apes and with possibly even fewer cells, they nevertheless demonstrate behaviour patterns that are human as opposed to pongid. Tredgold has described some of the behaviour patterns of microcephalics in this way:

> The mental features common to most microcephalics are the absence of sensory defect, a general vivacity, restlessness and muscular activity, a considerable capacity for imitation and, usually, an inability for sustained effort. In their perceptive faculties these persons often compare favourably with aments of considerably higher intelligence . . . .[23]

It is sobering to think that idiots, as microcephalics are often considered, are far more human than the most advanced nonhuman primates and more human than we may sometimes wish to accept.

While one could analyze the characteristics of man's brain in immense detail, contrasting it at each point with non-human primates, a few areas will be sufficient for our purposes. Of the development of the cerebral hemispheres, an extremely important feature concerns the parietal region which is greatly expanded and which is vital for the development of language and conceptualization. The expansion of the frontal lobes in man is a contentious issue, although it is worth mentioning as it appears to be involved in behavioural characteristics such as motivation and social control. The region involved in sight is again well developed, although this by itself does not characterize man.

In general terms the brain of man in its total complexity and organization underlies all facets of man's uniqueness. J. Z. Young contends that: "what the neurobiologist finds out about the brain must surely be relevant to fundamental views of the nature of all this knowledge."[24] From this it follows that "the whole structure of our language and thought is limited by a pre-programme in the organization of the brain."[25]

The Dental Apparatus

The most noticeable difference between man and nonhuman primates is the absence in man (especially males) of large, projecting canines.[26] Furthermore, the canines which are present resemble incisors in shape and lack almost totally the sharp, conical aspect of the nonhuman primates. As a result incisors, canines and premolars form a continuous series in man.

Looking at the dental arcade, we see that it is rounded at the front, while the premolars and molars are parallel on the two sides or even divergent. Linked with these dental changes is the overall structure of the face in man which is short from front to back, and also light. These changes are associated with an improvement in the efficiency of mastication and an increase in the force of chewing in man.

Further Features

Before we leave the overtly physical realm, a number of other human characteristics should be taken into account.

The first of these is the slow rate of human development, the goal of which is to delay the onset of sexual maturity. This slowing-down process is known as *foetalization*, because it prolongs into postnatal life the foetal characteristics of earlier ancestral forms.[27] The extent of this process in man can be appreciated when we consider that the period from birth to the onset of sexual maturity occupies approximately 20-25% of his lifespan, compared with as little as 8-10% in some animals. Bronowski has termed this prolonged period of childhood "the postponement of *decision*"[28] period, during which sufficient knowledge is being accumulated as a preparation for the future. Such a period increases the time span during which the maturing human can acquire knowledge by observing, listening, imitating and growing into an individual person.[29]

One possible by-product of foetalization is man's *nakedness*. This suggestion is made because the distribution of hair on man is very similar to that on a late chimpanzee foetus.[30] This is just one of a number of possible explanations for human nakedness, others being that it is related to hunting in a hot climate[31] or to an aquatic stage in his evolutionary past.[32] Whatever the merits of such suggestions, the fact is that nakedness, while not unique in the animal kingdom, is highly unusual amongst terrestrial animals. And we all know that it distinguishes the human 'apes' from all other apes, to borrow Desmond Morris' allusion![33]

The *sexual life* of humans, although showing numerous similarities with the higher primates is notable on a number of grounds. These include the lack of a definite breeding season, and this carries with it the corollary that man is *continuously sexed*. Furthermore, man is unique in his *reproductive variability*, pointing to the importance in human communities of differential fertility. Allied to these characteristics is the length and relative importance of *post-maturity* in humans, that is, the period of time after the cessation of active reproductive capacity.[34]

Characteristics of Man's Brain

I have already looked briefly at a few of the distinguishing features of the human brain. In this section I want to examine what may be called the *products* of such a brain, namely, language and thought.

Language

Man can be described as having two language systems: a thinking language for manipulating concepts inside his head and a speaking language for communicating with others.[35] Whether or not this implies that other primates have thinking languages I do not know. The important point it does bring out though, is that man is man because he can communicate with other men by means of speech. As we are all fully aware, numerous animals communicate with each other via olfactory, tactile, visual and auditory signals. Nevertheness such communication is far removed from the very fertile communication system in man. Even the range of calls made by chimpanzees and baboons is limited to a fixed system in which each sign has only one meaning.[36]

Human speech is a genuinely *linguistic* signalling system, and what is significant about this type of system is that it is an 'open' one. In other words, it provides a means whereby a very large number of signals can be combined to produce *new* words and combinations of words. Because it is not programmed in the brain, it is capable of infinite modification at will.[37] All other signalling systems are 'closed' and hence lack the potential of a linguistic mode of communication.[38] It has also been suggested that the communication systems of nonhumans are concerned with the animal's motivational state, whereas humans with their linguistic system are liberated, as well we know, from such restrictions.[39]

Language is also of importance in that it enables an individual to learn from a variety of other individuals and not solely from his parents.[40] This is one aspect of *multiparental inheritance*, in which a supra-heredity form of inheritance is introduced into human experience.

What makes language possible? As we should expect by this stage, the answer is a complex one, involving the brain, the larynx and the tongue among other things. In the majority of human beings (about 98% of the population) the areas of the brain concerned with speech are localized in the left cerebral hemisphere, the so-called dominant hemisphere. What is illuminating about these speech centres is that, not only are they closely associated with each other, but they are also intimately linked to the motor areas concerned with movements of the lips and tongue, and to the areas involved with hearing and sight. Both developmentally and functionally therefore, speech forms part of a larger system incorporating the whole of the sensory input to the brain, and it plays an essential role in the way in which the brain responds to its environment. Without such a comprehensive response, man would not be recognizable as the man we know today, and he would certainly not have produced the culture we see around us.

Thought

Under this heading I want to concentrate on man's ability to form abstract concepts and to generalize.

One of the glories of the human intellect is that it allows man time to ponder and to meditate. Of course for such activities to be possible in the first place, a requisite level of intelligence is required. But given this, man is capable of indulging in activities—whether physical or mental, which have no immediate goal.[41] If you like, man is capable of play long after his childhood has passed. What this means at the intellectual level is that man in his thinking can make and use *abstract concepts*.

Concept formation involves the isolation of certain features or attributes of an object from the object itself. Taken further, more elaborate concepts involve abstraction from the data provided by a number of the senses.[42] From here it is but a short step to the *invention* of new ideas and to the interplay of ideas. This latter attribute calls forth *imagination*, from which arise poetic language and scientific concepts.[43]

Before concept formation can be adequately utilized another trait is essential, and this is *generalization*, which lies at the basis of all human systems of explanation and forecasting.[44] In McMullin's words: "When man seeks to understand, he is capable of going far beyond the given or the experienced; he can bring the entire universe into the net he casts."[45] Not only this, he can integrate the present with the past and, to a limited extent, the future as well. Being capable of thinking in these abstract and general terms, man is in a position to attempt to *understand* himself and his world.

Having traced our way through man's physical characteristics we have now come to those attributes which man sees on looking at himself as a person and as an individual. However subjective some of these may be, we should not forget that they principally arise from the characteristics of man's own brain.

Man's Conceptual World

The topics covered in this and the next two sections cannot be readily isolated from each other. While I have separated them under different headings, there is considerable overlap and interplay between some of them.

The Self

I do not intend to enter the realm of philosophy at this juncture, but I would like to touch on areas such as self-knowledge, self-understanding, self-consciousness and self-awareness. Regardless of the precise connotations of each of these terms, they remind us of man's concern with his own being, a uniquely human concern, one imagines.

Man possesses a degree of self-knowledge, and he is continually confronted by a demand that he not only knows but understands himself as a human being.[46] Involved in these pursuits is the awareness of other people and their projected images, and in the wake of this awareness is a comparison of how we match up to those alongside us. The result of these encounters with ourselves and other people is a growing awareness of who we are. This is our self-consciousness and it helps remind us of the limits of our persons. To identify ourselves with our bodies is indeed one of the supreme achievements of the human brain.

Self-consciousness carries with it therefore, the implication that creatures characterized by it *know that they know*.[47] By contrast, even the most highly developed nonhuman primates are restricted to knowing; they are knowing creatures as opposed to self-knowing ones. Self-consciousness ensures that man is continually asking questions, about himself, his existence, his destiny and about any and every aspect of his world. He is a questioning and an answering being, because without answers self-consciousness is self-limiting.

Creativity

As I have hinted already man's conceptual attributes have placed him in a position where he can create

The Christian view that man is rooted in nature and formed in the image of God is an elaboration and radical development of the biological position.

new ideas, imagine new solutions to problems and question his own existence. In short, they have bestowed upon him creativity and inventiveness. Man therefore, and man alone of course, is the creator of his own world and the roots of this lie in his powers of conceptualization.

McMullin expands on this idea in these words:

> Only man can fashion at will a symbolic system which he has the power to modify and improve in order to make it a more effective lens on the world. Man's creative understanding shows itself . . . in the constant restructuring of symbolic forms in a restless and never-ceasing effort to understand.[48]

Other attributes essential to creativity are planning, forethought, memory[49] and curiosity,[50] while a sense of time[51] and a perspective on the future are closely intertwined with it. These, acting together, make man a truly creative being, planning actions far in advance,[52] devising new ways of doing things and living as much in a world of his own making as in the physical world around him.

Man's Culture

The concept of culture is generally used to cover all those skills and ways of life that are transmitted non-genetically.[53]

Cumulative Tradition

The means of transmission of ideas is by interpersonal communication and tradition. In other words, no matter what particular culture we are concerned with, however 'primitive' or 'advanced', its basis lies in the ability of man to communicate linguistically and, in more advanced cultures, also by art, writing, the production of books, poetry, science, technology etc. Culture therefore, is nothing other than a world of man's own making. It is the extension of creativity into the world created by many brains in a particular geographical area at a particular stage in history. Today however, with the increasing prominence of a universal cultural system, it is the combined product of millions of brains spanning the globe. No matter how large or small a culture is, it remains the product of man himself and may be viewed as an extension of man's attributes beyond his own body and hence beyond his own physical boundaries.

Present concern over man's relationship to his environment is simply an extension of this principle. Man's ever-increasing technological prowess has brought the environment within the scope of man's cultural domain, and hence within the realm of man's creative talents. The environment in its relationships to modern, modern man (that is late twentieth century man), occupies a place in the world of man's own creation. Hence it is subject to man's manipulation and control.

Similarly man himself is subject to his own control, whether it be in the spheres of reproduction, genetics

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or the brain. Man's own body is therefore, increasingly being encompassed by the constraints of human culture. Man is making himself increasingly unique, if we can use such a term, because he is producing for himself an increasingly different world which is man-constructed and man-centered.

Similar ideas are often phrased rather differently, namely, that man can now control his own evolution. Huxley speaks of psychosocial evolution which is the cultural phase of evolution.[54] From this he draws out the implication that man is now the only agent for realizing life's further progress, the future of life depending therefore on his ability to understand, control and utilize the forces of his own nature.[55]

Arts and Sciences

The foundations of advanced cultures are found in art, books, literary endeavour and science.

Artistic endeavour has a long history, and the earliest representations that have survived are in the form of carved figures, either on cave walls or as small statues.[56] These, dating from about 25,000 years ago, depict either human or animal forms. They may, in part, have served as communication symbols conveying information about people who were not present. Cave paintings, the earliest surviving examples of which date from about 30,000 years ago, are often dominated by animals and animal heads. Their significance is a matter of debate, but it is reasonable to suggest that they may have served as pictorial adjuncts to verbal communication while they may also have had some form of ritual associations.[57]

The essence of *writing* is that it enables information to be stored outside the brain. It is, in other words, an *extra-corporeal information store*.[58] The revolutionary impact of writing is that it has led to a previously unprecedented increase in human knowledge. As we all know, we ourselves are limited in the amount of information we can remember, but once we build up a library of books, we have at our disposal an information store far greater than we could ever retain in our brains. Books and libraries therefore, are simply extensions of our brains or more specifically of our cerebral hemispheres. To put it another way, they are man-made memory stores. Bronowski has used a rather different expression to describe books, and it is this: with books comes the democracy of the intellect.[59] Man, particularly when in rebellion against those around him, is freer to express his views and his dissent on the printed page. He is thereby set free from constraints which would be inevitable in a non-literary culture.

The scientific enterprise can be understood in terms of man's biology if we synthesize a number of the attributes we have already considered. Man's ability to stand back from a problem and view it in dispassionate terms is indispensable. So too is his ability to view one problem in terms of principles derived from other areas of knowledge. So too is his capacity for generalization and abstraction. So too is his capacity for accepting a solution as temporary, knowing that it will be supplanted at some future date by an alternative solution.

Science therefore, embodies man's tentative excursions into his world, rendering them a part of his culture. It is organized experimental creativity.

The Human Person

Man is characterized by a desire to *know* and to be known. Each individual has a sense of his own personal uniqueness, he is aware of his transience and he knows that one day he will cease to exist. Alongside such thoughts go specific questions. What is my destiny? Where am I going? What is life all about? Questions such as these characterize human thought and introduce into his thinking an overtly religious dimension. Man's life is a search after meaning in a universe where otherwise there is no meaning. In Eccles' words:

> Because of the mystery of our being as unique self-conscious existences, we can have hope as we set our own soft sensitive and fleeting personal experience against the terror and immensity of illimitable space and time.[60]

Religious Dimensions

Malinowski made the statement:

> Religion . . . can be shown to be intrinsically although indirectly connected with man's fundamental, that is, biological, needs. Like magic it comes from the curse of forethought and imagination, which fall on man once he rises above brute animal nature.[61]

Underlying these ideas is the fact of man's transience and the fact that he knows he is transient. Religion has therefore, been viewed by Feibleman as: "an effort to be included in some domain larger and more pertinent than mere existence."[62]

The recognition of death is an ancient one, and is well known amongst nonhuman primates such as baboons.[63] Burial of the dead however, signifies more than mere recognition of death. It involves some idea of an afterlife, and it is generally contended that Neanderthal man buried his dead with ceremony.[64] The only other signs of religious activity before modern times were artificial hills which may have been religious in function. It is only from about 10,000 years ago however, that obviously recognizable shrines and temples become commonplace, signifying that the religious life of man had become well and truly established.

Death-awareness

Starting from the acknowledgement that one of the most fundamental features of man is his self-awareness, Dobzhansky argues that this has brought in its train fear, anxiety and death-awareness. "Man is burdened," writes Dobzhansky, "with death-awareness. A being who knows that he will die arose from ancestors who did not know."[65]

Dobzhansky contends that, while death-awareness is not genetically controlled, it is a basic characteristic of man as a biological species.[66] Death-awareness, in its turn, is a prelude to what Dobzhansky calls man's *ulti-*

mate concern, [67] that is, his concern with things beyond himself and his present life; it is concern with the infinite. This brings us back to man's quest for meaning in life, a search which appears to be an integral part of man's make-up.

Man a Machine

In spite of the apparent freedom exercised by man in looking beyond himself, biological approaches to man inevitably raise the question whether man is simply a machine.

Some assert that this is indeed the case—man *is* a machine, and as such should be able to act in thoroughly objective ways.[68] Others however, while conceding that it is useful to describe many of the actions of man in machinelike-terms, distinguish between this useful analogy and the direct statement that he actually is a machine. Man then, according to such people is *like* a machine.

If man is not a machine, why is this? A machine, after-all, is a human artefact, it is a product of man's brain. Because we speak so frequently in picture language, comparing that which is unknown with that which is known, it is profitable to use machine analogies. These however, give us no fundamental information about the *nature* of man, only about certain descriptions of him. A holistic view of man, including his experiences and emotions, belies the apparent simplicity of man-is-a-machine explanations. To suggest that we fully understand machines, tells us more about the simplicity of the particular machines than about our ability to understand them. To suggest that we can say with confidence that man is a machine tells us little about man, something about machines, and a great deal about our naivete.

Being Human

We started off by asking the question: 'What is Man?' How far have we come? Are we any nearer an answer? Is the question correctly worded?

'*What* is Man?' implies that man is a thing, an object to be analyzed, weighed, measured and assessed. But is he this, and if so is he nothing more than this? You might expect me as a biologist to accept the question in this form without complaint. Our discussion though, has taken us beyond the narrowly experimental and has forced us to look at man in his own right, as a person and not merely as a primate different from other primates. Admittedly, the so-called *personal* side of man stems from biological characteristics, and in particular the organization of his brain. But man, the person, still confronts us.

Let us also ask the question then, '*Who* is Man?' In this form the question brings to the surface the worth and the status of man. It prompts us to ask: What is meant by *being* human.[69] Above all, we need to ask: Where are we going? Where am I going? Where is technological man going? Whatever our answers to these questions they assume that man, both individuals and the species, has worth. They are responses to the question 'Who is Man?'

As a biologist and a human being, because I cannot split myself into one or the other, I recognize a need for both questions. Man can be described fairly fully in purely biological terms, but he also insists on presenting himself to us as a being of value, as a person continually asking questions and continually searching for meaning in his life. These are not mutually contradictory sides to man; they are different levels, each essential for a unitary view of the whole man. Whatever else man is, he is a whole. When he loses his wholeness, he lapses into ill-health. Similarly, when we as observers of man ignore his wholeness, we see not man but something less than man.

A Christian Assessment of Man

All too frequently man is approached in a fragmentary way, the implication being that a unitary view of man is unattainable. And yet this survey of man based on the attributes and aspirations of human biologists has brought us surprisingly far. It would of course be misleading to suggest that there is a consensus of opinion among human biologists on all the issues I have raised. Clearly this is not so and the further we have moved from the narrowly biological the greater is the divergence of opinion. Nevertheless the very fact that man's culture and person can legitimately be discussed within the framework of human biology demonstrates the wide scope of this approach.

But in spite of this, is there not still an immense jump from the type of conclusions we have already reached to a Christian view of man? To answer this question we need to remind ourselves of some of the conclusions at which we have arrived. Man can be distinguished from other primates on the basis of his use of tools, his posture, many of the characteristics of his brain and his prolonged childhood. His language system and powers of abstract reasoning and generalization not only set him apart but also place him in a position to understand and mold his world, an ability immeasurably enhanced by his self-knowledge and creativity. Unfortunately or fortunately for man these characteristics leave him dissatisfied with what he sees and feels in his immediate world; he longs to know more, he longs to understand more because he knows he is finite. Hence the inevitable religious dimensions to his life with their emphasis on his ultimate concern. Man knows there is meaning for his life if only he can find it. And so man must attempt to know who he is and what place he occupies in a world of immense and exciting possibilities.

Man is an enquiring animal. He is unique in his search for truth, concern for moral values and acknowledgement of universal obligations.[70] He is rooted not merely in his biological connections but also in his ethical aspirations. In many ways man is a moral being having a strong sense that some actions 'ought' to be done and others 'ought not' to be done.[71] He is a creature of this world but is not limited to its immediate, material dimensions. He is explicable in biological terms only as long as the human and ethical side of his nature is not overlooked. And it is the *human* side of man which is the exciting and forbidding one.

How can we advance in our understanding of man in his totality? Is he *more* than an equiring animal? Can he be a *fulfilled* one? Are there answers beyond the reach of human biology and is this where Christianity comes in?

As we have already seen, man is *rooted in nature*, sharing the finitude, creatureliness and death of all living things.[72] "You are dust and to dust you shall return."[73] And yet man is more than this. He has a special relationship to God and in some senses he is like God. "Then God said, 'Let us make man in our image, after our likeness . . .'. So God created man in his own image, in the image of God he created him."[74] From this we can conclude that, like God, man is personal, he can think and communicate, he is rational. Like God he has emotions and can feel, he can make certain free choices, he is responsible and accountable.[75] Man then, and man alone is a responsible self who can be addressed by God and who can respond to the demands of righteousness and justice.[76] Man cannot help seeing himself as over against a god, to whom or to which he recognizes he has obligations.[77]

This is the beginning of a Christian view of man. At no point does it depart from what we learn of man from the perspective of human biology. Rather, what it does is to usher in an additional perspective, one which revolutionizes the biological one because it places our view of man on a different footing, thereby providing a complete picture of him. In doing so it provides a means by which man's yearning for that which is beyond him can be met. And as we have already seen, this need is a biological one. The Christian view that man is rooted in nature and formed in the image of God is an elaboration and radical development of the biological position. It is broader than the biological one embracing the latter within its compass and setting it in a dynamic God-man, Creator-creature dialectic. For the Christian, man has a meaningful relationship to the Creator, and is capable of a level of experience and existence quite different from all other living things.[78] Man is made with the intention of responding to God's gracious word in personal love and trust, and only in this response can he be what he truly is.[79]

This brings us to another important principle: man is a *unity*. He is not just body, neither is he just soul; he is not just material, neither is he just immaterial. In each instance he is both, Man is a totality; he is a unity. To suggest as did the Gnostics that matter is inherently evil is a sad denial of the Bible's affirmation of the natural order and hence of matter. At the same time however, the limitation of man's horizons to matter is a gross denial of his relationship to God and of his grounding in the purposes of God. Man is a unity transcending the vistas of the observable and yet thoroughly biological in all he is.

How does this help us? Is the idea of unity alone sufficient? Probably not, because man is a unity requiring description and explanation at a number of levels. To use Ian Barbour's phrase, he is a *many-levelled unity*[80] What this means is that, as Richard Bube puts it:

> Man can be understood only when described as a machine *and* as a person created by God, created with real personality in the image of a personal God but functioning on the biological, biochemical, and biophysical levels according to the laws that govern the rest of nature as well.[81]

The image of man to emerge from human biology is a multi-levelled one, as human biology itself encompasses a range of related disciplines. This is useful and as we have seen it presents us with a surprisingly comprehensive picture of man. By itself however, it cannot be a complete picture because it omits—as indeed it must—man's relationship to God. Only as this level of description is taken into account does man assume his true position in the world and his rightful status as a responsible personal being.

It is only in the context of a universe which has meaning that man can himself aspire to meaning. And a God-centered universe is indeed one which has meaning and in which life can be seen as having beauty and value. For the Christian, the universe and hence man has value because a personal God has created it and created man within a framework of personality. In a personal, caring universe man can find *meaning* and *value*, not only as a species but also as an individual. The enquiring animal can become the purposeful animal, but first he must recognize his need of God and the requirement that he enter into a true relationship with God and his fellow-man.

What is man? Perhaps the Christian would prefer to ask what it means to be human, and whether man can be fully human outside a Christian frame of reference. For the Christian, man stems from the purposes of God and achieves both significance and freedom within the designs of God. Man is free to go his own way; he is free to construct his own frames of reference; but the only freedom that will enhance his human status is one grounded within and developed according to the precepts of his Creator and Redeemer.

From this it follows that man is a being of immense worth, and under no circumstances is he to be despised. The psalmist described man's stature in unforgettable terms. "What is man that thou art mindful of him?" he asked, only to reply: "Thou hast made him little less than God, and dost crown him with glory and honour. Thou hast given him dominion over the works of thy hands; thou hast put all things under his feet."[82] Man, of course, is far from perfect; all too often he misuses his abilities and misdirects his energies. Nevertheless, even though he is a fallen being, he remains a being facing God. And this must be our point of departure as we seek to understand the depths and the heights, the potential and the limitations of man.

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An Anthropological Perspective on Man

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Introduction

"Man" and "human" are not scientific, but rather colloquial terms. In considering the relationship of man to other organisms—the question of taxonomy—it is preferable to use terms such as hominid or *Homo sapiens* rather than "man." For most people the term "man" has a very restricted meaning, referring only to *Homo sapiens sapiens* (Clark 1955:6).

There is actually little agreement on what is meant by "man." Some emphasize the achievement of upright posture, others the acquisition of language, and still others the use of tools or the attainment of large brain size, etc. (Quigley 1971:520). In a review of John Pfeiffer's *The Emergence of Man*, L. S. B. Leakey (1971:381) claims that it is not clear whether Pfeiffer is equating man with the genus *Homo* or only with *Homo sapiens*.

Simpson claims that all attempts to answer the question, "What is man?" before 1859 are completely worthless and should therefore be studiously ignored. In discussing the nature of man the only fixed point of departure is man's biological nature, both in its evolutionary history and present condition. Simpson recognizes that a biological study of man may never give a satisfactorily complete answer to the question, and that the older approaches through metaphysics, theology, art, and other nonbiological, nonscientific fields can still contribute.

> But unless they accept, by speculation or by implication, the nature of man as a biological organism, they are merely fictional fantasies or falsities, however interesting they may be in those nonfactual categories (Simpson 1966:3).

Not everyone agrees with Simpson on the basic importance of man's biological nature. Others (cf. Quigley 1971:521; Roe 1963:320) note that most of the criteria which have been suggested for differentiating man from other animals are behavioral in nature, rather than changes in physical structure which can be documented by the fossil record.

One problem in considering the nature of man is that certain terms may be interpreted differently than the user intended. For example, the statement that man is an animal is interpreted by some to mean that man is *simply* an animal, and therefore they feel compelled to reject the statement. Bube's introduction to a special edition of the *Journal ASA* on whether man is only a complex machine deals with an analogous problem:

> It's the "only" in the question, "Is man *only* a complex machine?" that causes the problem. . . . That man is a complex machine is a scientific conclusion. That man is only a complex machine is a subjective philosophical speculation not derivable from science. . . . We should expect that every event in which a human being takes part can be described on each of the levels appropriately associated with the physical sciences, the biological sciences, the psychological and social sciences, and ultimately in terms of that theology which relates the event and the man to God. It is never a question of something happening on this level but not on another; it is always a question of something happening on every level simultaneously (Bube 1970:122).

It is difficult to be "objective" about the nature of man, for we all have so much vested interest in the conclusions. Man has been characterized in many ways: a little lower than the angels, a mechanical misfit, a ridiculous weakling, and/or the most dangerous creature alive. It is obvious that these statements are based on value judgments and are not open to scientific verification.

In this paper I would like to explore the question of the uniqueness of man from three different perspectives: paleontology, biochemistry, and language.

Paleontology

In 1961 Howell stated that "Human evolutionary studies are still greatly hindered by a taxonomic morass which is seriously in need of revision" (1961:119), and acknowledged the difficulty of applying the biological species concept to fossil populations. The situation has improved little (if any) since then. Livingstone (1961:117) has complained that to most physical anthropologists, a bump here or a difference of a centimeter someplace else is conclusive evidence for placing two specimens in separate species, and that the process of, e.g., assigning mandibles to different species on the basis of morphological differences, makes neither ecological nor morphological sense.

> I would go even further and maintain that we shall never infer or understand the course of human evolution by comparative anatomy or detailed analysis of the miserable scraps of bone which have been found. Only by considering these scraps as living, kicking animals who thus conform to all the general laws of ecology and evolution will we ever understand our own ascent or descent (Livingstone 1961:117).

The fact is that the judgments of anthropologists on anatomy, taxonomy and phylogeny are liable to error, controversy and revision. "Yesterday's *Paranthropus* becomes today's *Australopithecus*, whilst today's *Australopithecus* is tomorrow's (though not yesterday's) *Homo*!" (Tobias 1974:410-11).

Campbell succinctly states the problem of taxonomy in relation to fossil forms:

> Paleospecies are sequent, continuous, and not discrete units, and they cannot be distinguished by morphological characters alone. Somewhere, many times, an *Australopithecus* gave birth to a *Homo* and they were indistinguishable at the taxonomic level. Nothing is to be gained by creating intermediate taxonomic categories, for neither morphological nor behavioral boundaries exist in reality, however hard we look for them (Campbell 1972:39).

In the past the general opinion has been that the more we learn about fossils, and the more of them we find, the clearer will be our understanding of their relationships to one another. However, it seems that the opposite is true.

> Progress in the study of human evolution based on the fossil record has been beset by nearly as many problems as it has resolved. While today we know far more of the fossil evidence than those who wrote early in this century, we have also come to realize more clearly the theoretical difficulties which stand in our way. We know that we can never do more than present hypotheses on the basis of presently available evidence. As time-bound creatures, no ultimate truth about the origin and evolution of mankind can ever be known to us.
>
> The recent discovery of so many fossil hominids has . . . opened up a wider range of hypothetical possibilities than have been appropriate in the past. . . . The numerous fossils now known offer alternative interpretations (Campbell 1972:27).

Leakey (1973:173) notes that the collection of hominids found in 1972 in the East Rudolph area of North Kenya has presented more questions than answers. He concludes that the pattern of hominid development in east Africa was much more complex than had earlier been thought.

An interesting approach to the problem of interpretation is taken by Wolpoff (1968). After admitting that one can never be really sure about which specimens constitute a species, he notes that the final interpretation must rest on the framework which one selects, and that the framework must be generated by one's hypotheses concerning the selective pressures that oriented human development. The best one can do is to choose the framework which most closely fits the "facts," and although the facts do not speak for themselves, we can always manage to do a great deal of talking for them. Wolpoff's framework is that man has adapted culturally to the physical environment, and morphologically to effectively bearing culture. "Because of this hominid adaptive characteristic, it is difficult to understand how different hominid species could have arisen or have been maintained sympatrically" (Wolpoff 1968: 479). He then concludes that "the question of sympatric hominid speciation is more than a mere taxonomic problem. An entire theory about hominid evolution is at stake" (Wolpoff 1968:480). He therefore accepts all hominids alive at a given time as being within the range of variation of a single species.

It is commonly held that beginning with the australopithecines there was no speciation, only phyletic change. However, the recent finds in south and east Africa seem to point to the conclusion that hominid development has been cladistic rather than only phyletic. In east Africa it seems that at least two types of hominid were in existence at the same time from the earliest stages of *Australopithecus*, and some australopithecines seem to be present with *Homo erectus* at Olduvai and Ternifine (Tobias 1973:326).

It is necessary to use imagination to develop models or hypotheses for handling the problems of human development, but we are still in a preliminary phase of the work—collecting data and attempting to put it in order. Although some seem to thrive on speculation (e.g., Todd and Blumenberg 1974), most prefer to be tentative in their reconstructions.

A few examples will serve to illustrate the "taxonomic morass." The *Meganthropus* mandibles were identified as *Homo erectus* by some and *Australopithecus robustus* by others (Wolpoff 1971:401). The Vértesszöllös find is classified as *Homo sapiens* by Raemsch (1974:436), whereas others classify it as *Homo erectus*. At Olduvai Gorge, Hominid 7 has been variously classified as *Australopithecus* and *Homo habilis*, and Hominid 13 as *Homo habilis* and *Homo erectus* (Kinzey 1971:531). As we now consider the fossil data, it is important to keep in mind Wolpoff's (1968:477) statement that "The interpretive problem is inevitable in the study of fossil man, and the question of which specimens do or do not constitute a species will always remain open."

The most commonly mentioned candidate for the earliest known hominid (on the line of modern man) is *Ramapithecus*, specimens of which have been found in both Africa and India. Unfortunately, the finds are extremely fragmentary, with no skulls, limb bones, or even canine teeth (Washburn 1971:534). For example, *Ramapithecus wickeri* consists only of an incomplete upper dentition in two maxillary fragments and part of the left side of the mandible.

This paucity of information does not deter some people from speculating broadly. Todd and Blumenberg (1974:383) state that there was an obvious extension of the juvenile period, which they infer from the differential attrition of the molar teeth which resulted from their delayed eruption. Poirier (1974:408) comments that if this is true (remembering, of course, that the evidence is from wear on a limited sample), the possibility has important implications for the "socialization and learning process." Blumenberg (1974:419) even maintains that the ecology and habits of *Ramapithecus* can be extrapolated from the presumably associated fauna, while others strongly disagree.

Although Campbell admits that "on superficial examination" the *Ramapithecus* specimens seem very ape-

The uniqueness of man from three different perspectives: paleontology, biochemistry and language.

like, he maintains that the total morphological pattern is not that of an ape and varies from it quite specifically.

> No one feature of this specimen can be characterized as hominid, as distinct from pongid, but the total morphological pattern is significant and falls very close to what might have been predicted for a form intermediate between an early *Dryopithecus* ape and an *Australopithecus* (Campbell 1972:30).

He then states that one's opinion of whether *Ramapithecus* is or is not on the line of man "can only be based on a personal assessment of very complex and conflicting evidence" (Campbell 1972:43). Others (cf. Aguirre 1974:399; Clark 1974:402; Kortlandt 1974: 429) have specifically questioned the hominid status of *Ramapithecus*, and Washburn (1971:534) argues that "dogmatic assertions of what our ancestors 'must' have been like or how they 'must' have behaved on the basis of this evidence is unfortunate."

The traditional viewpoint has been that the genus *Homo* evolved from the australopithecines. Depending on one's interpretation, it was either the gracile (africanus) or the robust (robustus) form from which *Homo* was derived. However, recent discoveries in east Africa have made the picture less clear. As a result of his work at Omo, Olduvai, and East Rudolph, Leakey (1971:244) has concluded that the data (both cranial and postcranial) seem to suggest that *Homo* and *Australopithecus* existed at the same time and shared the same habitat. The East Rudolph specimens of *Australopithecus* date from about 3 m.y. (million years ago) to just over 1 m.y., with very little morphological change during that time. Those classified as *Homo* have been recovered from deposits covering a similar time span, but show greater morphological variation (Leakey 1974:653).

The mandibular specimens from East Rudolph which have been attributed to *Homo* are in many ways similar to those specimens included in the africanus collection from Sterkfontein, South Africa. Therefore Leakey (1972:268) has concluded that the latter collection contains specimens that represent two different lineages —*Australopithecus* and *Homo*—and has recently (1974: 655) concluded that the East Rudolph forms of *Australopithecus* are much like the robustus forms from south Africa. It is very probable that the finds which Leakey (1972) has classified as *Homo* at East Rudolph would have been called africanus if found in other areas (cf. Robinson 1972:240). Robinson would solve the discrepancy by transferring all africanus specimens to *Homo*, which would result in three species of *Homo*: *Homo africanus* in south and east Africa, *Homo erectus* for the Java, Pekin, etc. finds, and *Homo sapiens* for the rest.

There is still the problem of chronology to be dealt with. Most of the K/Ar (potassium-argon) dates for the australopithecines have been very early, leading to the conclusion that the robustus form died out, leaving the africanus form to give rise to *Homo*. However, the discovery in Kenya of a specimen which seems to belong to the robustus form and which is dated by K/Ar at 1.1-1.2 m.y. raises further questions. Were the robustus forms really an over-specialized group heading for extinction, or were they as recently as 1 m.y. still a viable and adaptable group (Carney, *et. al.* 1971: 514)?

Swedlund (1974:519) argues that if there were in actuality two australopithecine species, they must have been allopatric—that is, not related—but arising from two different lines. He (1974:525) believes, however, that the africanus and robustus forms fit most logically into a *single* species, and that those who want to separate them must develop a credible ecological framework to explain the extinction of the robust forms. The only infallible criterion for defining a given species is whether or not the individuals comprising the study population are capable of interbreeding successfully, and since we have no indication of this for the australopithecines, the answer can only be tentative.

It has also been hypothesized (Butzer 1974:382) that the Taung specimen (which was the first *Australopithecus* discovered) may postdate the arrival of true *Homo* in southern Africa, which would open a new range of problems concerning the relationship between the two forms in that area.

The discovery of the KNM-ER 1470 skull at Koobi Fora (Leakey 1973) has caused further speculation. The cranial capacity of the find is aproximately 800 cc, and the probable K/Ar date is 2.9 m.y., which means that a *Homo* form predates many of the australopithecines in east Africa. One interpretation of the data posits a sympatric relationship between *Homo* and *Australopithecus,* with *Homo* providing scavenging opportunities for *Australopithecus*:

> However, as *H. erectus* developed ever more sophisticated behavioral and technological means of defense against predators, the utility of the relationship with australopithecines would have diminished. The gradual extinction of *Australopithecus* may have been an inevitable outcome of the breakdown in association with *Homo*, for predation pressure would inexorably have shifted to *Australopithecus* (Todd and Blumenberg 1974:387).

Needless to say, this reconstruction has not met with unqualified approval. To quote one critic:

> I can only remark that such unbridled speculation can be justified only by accepting at face value the unwarranted assertions of many authors, interpreting altogether too liberally the cautious statements of others, and exercising a selectivity that excludes from consideration voluminous contrary opinion (Kress 1974:405).

As the above data show, there are a number of different interpretations of the African fossil finds, each of which can be supported by experts. One can argue that the robustus and africanus forms of *Australopithecus* belong to separate genera, or belong to separate species, or were simply the males and females, respectively, of the same species. In interpreting the relationship between *Homo* and *Australopithecus*, possibly only the robust forms should be classified as *Australopithecus* and the africanus forms as *Homo*. On the other hand, possibly some of those now classified as *Homo* should be reclassified as africanus. One can argue that there was only one hominid species alive at a given time, or that there were two (or more).

According to the most generally accepted framework, the *Australopithecus* stage of human evolution was followed by the *Homo erectus* stage, which in turn was followed by the Neanderthal stage, and finally by modern man. Ordinarily all hominids beginning with Neanderthal Man are labelled *Homo sapiens*, and there are even those who would include the *Homo erectus* forms in that species. Modern man is then classified as *Homo sapiens sapiens* to distinguish him from *Homo sapiens neanderthalensis.*

Much controversy still exists about the relationships between Neanderthals and anatomically modern *Homo sapiens*, with widely different interpretations being used. Brose and Wolpoff (1971) argue against the quite commonly held theory that Neanderthals were replaced by *Homo sapiens sapiens*, and insist that the latter (in the form of Upper Paleolithic man) evolved from the Middle Paleolithic Neanderthals. Their definition of Neanderthal, which includes "all hominid specimens dated within the time span from the end of the Riss to the appearance of anatomically modern *H. sapiens*" (1971:1156), raises problems. For example, this would include Fontechevade, a find which is considered by others to be *Homo sapiens sapiens.* Their suggestion that *all* populations of modern man are derived from a universal Neanderthal population is not meaningful in terms of populations (Howells 1974:25). Brose and Wolpoff do not deal with the Swanscombe find—which is Second Interglacial in date—but others (e.g., Howell 1960) would classify it as well as Steinheim with the Neanderthals in spite of its more modern characteristics.

The relationship between the "progressive" (more modern appearing) Neanderthals like Skhul from Palestine and the "classical" (more primitive appearing) Neanderthals is not clearly understood. One of the major problems is that the progressive forms predate the classical forms. Brose and Wolpoff (1971:1183) classify Omo 1 and Skhul 5 as transitional Neanderthals, but admit that both would be identified as *Homo sapiens sapiens* if they had been found in a different geological context.

Gallus (1969:495) suggests that the classical Neanderthals may be seen as a subspecies which like *Homo sapiens* evolved from the *Homo erectus* substratum, but lost plasticity early and changed very little. It is therefore neither a descendant of early Neanderthals nor an ancestor of *Homo sapiens sapiens.* Howells (1974:26) would prefer to recognize a category of "*archaic Homo sapiens*" which are not at all Neanderthal in the strict sense.

Which of these fossil forms can we call "man"? If one uses the criterion of religious beliefs, then Neanderthals almost certainly qualify because they had many of the same practices which we classify as religious when found among peoples living today. If one uses the manufacture and use of tools in a certain pattern, then we have man at least as early as the *Homo erectus* forms. There has been a continuing controversy over whether *Australopithecus* made stone tools. It has been claimed that the Oldowan culture was a product of the australopithecines, but later L. S. B. Leakey attributed it to *Homo habilis.* With the discovery of KNM-ER 1470, the possibility that only *Homo* was a maker of stone tools has again been suggested (Blumenberg and Todd 1974:387).

Biochemistry

Another way in which scientists have attempted to understand the place of man in nature is to compare contemporary man with contemporary great apes. If they had a common ancestor (which evolutionists believe to be true), there should be biochemical similarities. Since man has more in common with the African apes (chimpanzees and gorillas) than with the Asian apes (orangutans and gibbons), most of the investigation has been on the former.

Soon after the field of molecular biology expanded in the 1950's, many researchers became interested in comparing proteins and nucleic acids of one species with another in an attempt to estimate the "genetic distance" between species. One method involved the use of the chromosome banding technique, by which chromosomes could be compared. It was discovered that the four gorilla chromosomes corresponding to human numbers 3, 13, 15 and X are identical in banding patterns with those human chromosomes. When the same method was used with chimpanzees, it was found that six chimpanzee chromosomes (corresponding to human numbers 3, 7, 8, 10, 14, and X) are identical with those of humans (Miller, *et. al.* 1974:537). It has been claimed that a total of fifteen chromosomes of man and chimpanzees have such similar banding patterns that homology seems clear in spite of minor differences; that there is general agreement on homologies for three more, with a fourth seeming highly probable; and that for the remaining four the homologies are considered to be far less certain (Warburton, *et. al.* 1973:457-59).

One major difference is that humans have 23 pairs of chromosomes, whereas chimpanzees have 24 pairs. One suggestion (Warburton, *et. al.* 1973:459) is that the short arm of human chromosome #2 corresponds to the long arm of chimpanzee chromosome #17, whereas the long arm of human chromosome #2 corresponds to all of chimpanzee chromosome #13. It has also been suggested (King and Wilson 1975:114) that if one takes the point of view that man and chimpanzees had a common ancestor, there were at least ten large inversions and translocations and one chromosomal fusion since that common ancestor.

Other similarities have been noted. For example, blood types A, B, AB, and O are found in chimpanzees (though they are not exactly the same chemically as in man), and chimpanzee hemoglobin seems to be identical with human hemoglobin (Buettner-Janusch 1973: 434, 460).

In summarizing the results of the biochemical comparison of man and chimpanzees, King and Wilson (1975:107) conclude that the "genetic distance between humans and chimpanzees is probably too small to account for their substantial organismal differences." Amino acid sequencing, immunological, and electrophoretic methods of protein comparison all yielded concordant estimates of genetic resemblance, all indicating that the average human polypeptide is more than 99 percent identical to its chimpanzee counterpart. They also found that genetic distance measured by DNA hybridization indicates that man and chimpanzees are as alike as sibling species of other organisms, and that the antigenic differences found among the serum proteins of congeneric squirrel species are several times greater than those between humans and chimpanzees (King and Wilson 1975:113-115).

The major problem to which King and Wilson address themselves is how the two species could be so distinct morphologically and culturally when they are so similar genetically. They finally conclude that there must be a small number of genetic changes in systems controlling the expression of genes, and that the organismal differences may be due to arrangement of genes on chromosomes rather than from point mutations (King and Wilson 1975:115).

Language

A number of attempts have recently been made to discover the language capabilities of non-human primates. Because chimpanzees relate relatively well to man, they have been used in these experiments. Since early attempts to teach them the use of vocal symbols was almost a total failure, current experiments utilize language without vocalization.

Probably the best-known instance is the work of the Gardners with Washoe (Gardner and Gardner 1969). Since hand signals are an important part of chimpanzee behavior in the wild, they decided to use American Sign Language (ASL) in which motions stand for words. It has been claimed that the most primitive and simplest capacity for language in humans is to give names to things (cf. Lancaster 1968:446). If this is correct, then Washoe used language, for there is evidence that she assigned names (cf. Bronowski and Bellugi 1970:670). For example, she used the sign for "dog" and "cat" in response to pictures of the animals in magazines, and even used the same sign for different breeds of dogs and cats. She also applied the sign for "open" to doors, bottles, the refrigerator, etc., and would sign "more food" when there was none in sight. Some other typical combinations of signs which Washoe used were "go in," "go out," "open key" (for a locked door), and "please open hurry" (Peters 1972: 39).

Another experiment was conducted with a chimpanzee named Sarah (Premack 1971). The basic linguistic unit chosen is the word (no phonemes are used), each of which is represented by a piece of plastic backed with metal, which adheres to a magnetic slate. The experimenters began with a two word stage, such as "Mary apple," which meant that to obtain an apple when Mary was present, Sarah would have to put the words in that order. She learned to distinguish between same and different: e.g., she was given two cups and had to place between them a marker meaning "same." The same process was used for testing for an understanding of different. Sarah not only learned the names of items, but was required to write, for example, "apple not name of banana." She also learned color, shape and size, and was able, for example, to put a brown colored object in a red dish when asked to. An interesting experiment involved Sarah's ability to produce sentences which were appropriate to the *behavior* of the trainer, rather than just behave in ways which were appropriate to the trainer's sentences.

> On each trial she was given three words—two color words and "on." She was required to place them on the board in a way that corresponded to, or described, the

> trainer's placement of the cards. Thus, if the trainer put the blue card on the green one, Sarah, who held the words "green," "blue," and "on," was required to write "blue on green." She was correct on eight of the first ten trials (Premack 1971:814).

Of course, it is possible that rather than symbolizing, Sarah was only connecting a piece of plastic with a given object. To test this possibility, she was given an apple and a pair of alternatives (e.g., red and green, round and square, square with a stemlike protuberance and plain square, etc.) and was required to indicate which of the alternatives was more like the apple.

> The properties she assigned to the word "apple" show that her analysis of the word was based not on the physical form of the blue piece of plastic, but on the object that the plastic represents (Premack 1971:820).

A computer controlled training situation devised for a chimpanzee named Lana was much more complicated. Each "Yerkish word" or lexigram is a distinctive geometric white symbol on a colored background, and the keys of a console are imprinted with these color-coded lexigrams.

> Each key is constructed of laminated clear acrylic plastic. Lamps located behind the keys allow for (i) no backlighting, when the keys are inoperative; (ii) low-intensity backlighting, when the keys are operative; and (iii) high intensity backlighting, which signals Lana that she has successfully depressed the key, whereupon a facsimile of the lexigram on the key surface appears on a projector above the console. The consoles were designed to allow for alternations in the position of keys so that the location of a key would not reliably indicate its meaning (Rumbaugh, *et. al.* 1973:731).

Each sentence must be ended with the period key, which is a signal to the computer to evaluate the communication. If the communication is unacceptable (that is, incorrect), the computer erases the projected images and resets the word keys. If the communication is correct, the computer also activates the dispensing mechanism which gives the requested reward, e.g., music, movies, M&M's, etc., and sounds a tone. To be acceptable, each sentence has to start with "please" and end with a period. An example of a communication would be "please/machine/give/M&M/period." To ensure that she was not just memorizing an order on the console, the keys were randomly assigned among others on the console. Lana has discerned that once she has made an error, there is no point in continuing a sentence. She then pushes the period key, which erases her abortive attempt, and tries again. The experimenters conclude that

> The results of these . . . experiments are taken as evidence that Lana accurately perceives Yerkish words, reads their serial order, and discriminates whether they can or cannot be completed in order to obtain the various incentives. And if successful completion of the valid sentence starts is viewed as analogous to typewriting, it can be said that Lana both reads and writes (Rumbaugh, *et. al.* 1973:733).

It has been argued that the results of such experiments give clear evidence for relatively simple semantic and syntactic comprehension competence in chimpanzees. Peters maintains that it is not our state of knowledge that segregates our linguistic capacities from those of other primates, but rather our state of ignorance and our prior methodological naivete. He strongly suggests that there are probably degrees of linguistic competence and that our ignorance is the only reason for not expecting that "at least some components of linguistic competence may be shared by a wider set of taxa than *Homo sapiens*" (Peters 1972:33). He is aware that we still are faced with the question of why, if chimpanzees can learn to develop such a system in captivity, they have failed to develop a communication system with proto-linguistic features in the wild (1972:45)

Not all researchers are convinced that the experiments demonstrate the linguistic capacity of chimpanzees. Mistler-Lachman and Lachman (1974:892) argue that the conditioning of Lana does not imply language use, and that there is no evidence that the meanings for terms, or syntax for strings exists anywhere but in the linguistic competence of the trainers. They also note that the highly structured and carefully controlled training procedures are totally unlike the circumstances in which a human child learns a language.

> The animal is reinforced with 100 percent consistency; it is presented with only well-formed strings; and only the well-formed strings for a particular phase of training receive reinforcement. In contrast, human children are inconsistently reinforced; they are presented with ill-formed strings; and their ill-formed productions are often rewarded, especially if they are factually correct (Mistler-Lachman and Lachman 1974:871).

Washoe seemed to use various orderings of words indiscriminately and did not differentiate the basic grammatical relations. Although signs for "you," "me," and "tickle," have occurred in all possible orders in Washoe's signed sequences, the different orders do not seem to refer to different situations in any systematic way. Her spontaneous signed combinations seem to represent unordered sequences of names for various aspects of a situation (Bronowski and Bellugi 1970: 672). Children do not need to be taught the rules of grammatical structure because they discover them for themselves. They not only have the capacity to learn names as they are specifically taught by other humans in the early stages of language learning, but more importantly, they have the ability to analyze the regularities in the language, to break down the utterances into component parts and then to understand the parts so that they can put them together again in new combinations. When one knows a language, it seems that the relationship between a sentence and the reality it refers to was achieved by putting the sentence together. Whereas, in actuality, it begins by taking reality apart.

> In short, we must not think of sentences as assembled from words which have an independent existence already, separate from any kind of sentence. . . . The experience of learning about the world consists of an inner analysis and a subsequent synthesis. In this way, human language expresses a specifically human way of analyzing our experience of the eternal world. This analysis is as much a part of learning language as is the more obvious synthesis of sentences from a vocabulary of words. In short, language expresses not a specific linguistic faculty but a constellation of general faculties of the human mind (Bronowski and Bellugi 1970:673).

It is, therefore, this process of total reconstitution which is characteristic of the human mind. At the present we have no evidence that the nonhuman primate is capable of doing this even when given the vocabulary ready-made.

Finally, Chomsky (1972:67) argues that a careful consideration of experiments with chimpanzees provides little support for the assumption that human language evolved from systems of animal communication. He concludes that they demonstrate more clearly that human language is a unique phenomenon for which there is no significant analogue in the animal world. The postulation of a lower stage in the evolution of language in which vocal gestures were used for expression of emotional states, and a higher stage in which articulated sound is used for expression of thought, leaves a gap for which Chomsky sees no bridge.

> There is no more basis for assuming an evolutionary development of "higher" from "lower" stages, in this case, than there is for assuming an evolutionary development from breathing to walking; the stages have no significant analogy, it appears, and seem to involve entirely different processes and principles (Chomsky 1972:68).

Chomsky also questions the concept that language is characteristically used to communicate information, either in fact or in intention. In reality language can be used either to inform or mislead, to clarify our thoughts to other people, to display our cleverness, or even simply for play. The crucial factor in understanding language and the capacities on which it rests is to ask *what it is*, not how it is used, or for what purposes it is used. When we ask what it is,

> we find no striking similarity to animal communication systems. There is nothing useful to be said about behavior or thought at the level of abstraction at which animal and human communication fall together (Chomsky 1972:70).

In summary, although many experiments have been devised to determine the linguistic capacities of nonhuman primates, it seems that possession of human language is associated with a specific type of mental organization, not simply a higher degree of intelligence (cf. Lancaster 1968:446).

Conclusion

What then is "man" from an anthropological viewpoint? In terms of language, there seems to be no question that he has abilities which are different in kind rather than only degree from all nonhuman primates. Although there are some close biochemical correspondences between contemporary man and the African great apes, there are crucial cultural differences as well as major morphological differences between the two groups. Conclusions from paleontology are difficult to draw because of the problems of interpretation. However, Neanderthals should almost certainly be classified as "man," and probably *Homo erectus* forms as well.

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When a civilization has jettisoned the platitudes of plain, ancient, moral truth that are the very guardians and guarantors of its people's real freedom and joy, then it sets itself on the feverish quest for excitements to replace that moral truth. This quest leads with depressing predictability straight through from the diverting to the odd to the bizarre to the grotesque to the bestial to the demonic. With increasing stimulus, boredom sets in, and at the same time the threshold of people's capacity for being aroused goes up and up. This is why pornography, orgies, violence, gladiatorial combats, and jiggery-pokery crop up in rotting civilizations: people are bored with ordinariness and don't know what to do, and it takes more and more to rouse them from their ennui.

Thomas Howard
"The Omen," *Christianity Today*, p. 9, August 6, 1976

Some Statistics of Recent Issues of the Journal ASA

	Volumes 20-22 1968-1970	Volumes 23-25 1971-1973	Volumes 26-28 1974-1976
Paid Subscriptions at Beginning of Last Year	2300	2673	3224
Total Pages	480	512	608
Papers	114	108	94
Book Reviews	46	102	104
Communications	56	49	50
Pages of Advertising	0	3¼	3½

The Nature of Man and Scientific Models of Society

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Most contemporary models of society spring from philosophical positions which are based on the Kantian dilemma. On the one hand certain commonly held models are based upon the positivistic tradition and view man as a determined object to be observed objectively. On the other hand, more recently developed models are based upon phenomenological tradition and view man as an undetermined subject who escapes scientific scrutiny. These models of society are examined in light of a Biblical view of the nature of man and society. Although these models do make some contributions, the positivistically based models fail to take into account man's unique humaness, the phenomenologically based models fail to take into account man's creatureliness, and thus both fail to see man as created in the image of God.

Thomas Hobbes (1947) wondered if it were possible to discover the foundations of social order in human society. He characterized the "state of nature" as one of "continual fear, and danger of violence" and human life as "solitary, poor, nasty, brutish, and short." While contemporary sociologists are preoccupied with the Hobbesian question of social order, they have for the most part rejected his view of man in the state of nature being base, brutish and self-centered. Likewise, most contemporary scientific models of society assume a basic order in society. Some leave room for social conflict, but they do not relate conflict to a model of man which views him as a free agent acting in a self-centered way.

Most contemporary models of society have been greatly influenced by the contrasting analytic and phenomenological philosophical traditions. These traditions are variants of the same basically post-Kantian themes. They both start from Kant's distinction between "noumena" and "phenomena"—between things as they are in themselves and as they appear in consciousness. Both traditions rejected Kant's notion of things-in-themselves; but did not revert to a pre-Kantian position. Instead, they dealt with the concept of "things-for-consciousness." Most significantly, the analytic tradition has emphasized the *objects* of consciousness, while the phenomenologists have emphasized the *intentionality* of consciousness.

The primary influence of the analytic movement on the contemporary social sciences has been the attempt to apply the logical positivist defense of reductive analysis to the methods of sociology and psychology. This has been the case both among the hard core behaviorists and among "positivists" in general. Behaviorism and structural-functionalism are models of man and society which are based on the positivistic tradition. In these models man is viewed as a determined object to be observed objectively.

On the other hand, more recently developing models of man and society are based upon the phenomenological tradition. In these models man is viewed as an undetermined subject who escapes scientific scrutiny. In this paper these models of man and society are critically examined in the light of a Biblical view of the nature of man and society. Then, based on a Biblical view of man, the elements of an adequate model of society are suggested.

The Nature of Man

An adequate model of society must be based upon a Biblical view of man in which man is seen as created in the image of God and exists as a distorted image of God. More specifically, as pertains to models of society, man should be conceived as: (1) an indeterminant being who can in part behave creatively and spontaneously; (2) a self-conscious being who is capable of goal-choosing activity; (3) a being capable of doing evil as well as good, and (4) a being who is responsible for his own behavior.

To affirm these aspects of the nature of man is not to say that man is not in a certain sense a product of society. We are not denying Durkheim's claim that society is a reality *sui generis* with a nature of its own. However, men's/women's actions in society are to a large extent determined by certain basic universal qualities of human nature. Society is both shaped by and limited in its effect by these qualities. Man and society are best seen as maintaining their distinctiveness in a dialectic relationship, where society is a human product, but nevertheless an objective reality, and man is a social product, but not only social.

Models of Society

Basic to scientific investigation are either explicit or implicit assumptions about the phenomena which are being studied. For the last three centuries the universe has been conceived as a machine, whose movements are precise and predictable and which can best be understood in terms of causal sequence. For a time only man escaped being thought of as part of this great machine, but then, man too came to be conceived as subject matter which could also be studied according to this causal model. Although behavioral scientists have not completely agreed in the extent to which they have assumed a mechanistic position, most have until recently held to a positivistic or neo-positivistic model of society. In the past decade there has been a movement among humanistically oriented social scientists toward phenomenological and existentialist models of man and society. At the risk of over-generalizing, we will attempt to discuss most contemporary models of society as either *positivistic* or *phenomenological.* Two additional types of models of society, *conflict* and *symbolic interactionist,* will be discussed separately due to their uniqueness.

Positivistic Models

The positivistic models of society are generally either causal (mechanistic) or teleological (functional). In the 1940's George Lundberg popularized the causal model in sociology with his book *Can Science Save Us*? Although his strict positivistic approach was a minority position, sociologists generally adopted some form of positivism and saw the method of the physical sciences as their ideal. Most contemporary sociologists who continue to assume a causal model of society are behaviorists. It is ironic that a psychologist, B. F. Skinner, has become the major proponent of a causal model of society since he began to argue for the application of the principals of operant conditioning to the societal level. Strict behaviorists like Skinner deny man's personhood by denying his subjectivity. Man is viewed as a physical object open to scientific scrutiny and description is in terms of a causal model. Events external to the individual are said to determine the behavior of the individual.

In the 1950's structural-functionalism became the dominating theoretical perspective in sociology. Structural-functionalists such as Talcott Parsons, Robert Merton, and Wilbert Moore offered some moderation in positivistic methodology. Nevertheless man continued to be viewed as an object for consciousness in a theoretical sense. In the teleological model of the functionalists man as a person was submerged. Man was viewed as a "personality system" determined by the "social system." Society became the determining force and man the determined object. Dennis Wrong has referred to the functionalist view of man as the "over socialized conception of man."

The functionalists share three assumptions about man which negate man's individuality and conflict with other individuals. First, actors are assumed to have acquired and internalized certain dispositions, e.g., attitudes, sentiments, and to be subject to certain institutionalized role expectations. Second, actors are assumed to operate according to certain fixed psychological principles, e.g., the reinforcement principle. Third, actors are assumed to share a system of symbols and meanings which serve as a commonly understood medium of communication for their interaction. This is the assumption of "cognitive consensus." These assumptions have led to an emphasis on normative behavior or conformity. Man is seen as a choice-making creature, but only within the realm of fixed values. Creativity is submerged. Societal integration is also emphasized, with conflict, deviance, and change being seen as results of social disorganization rather than intrinsic social processes.

These positivistically based models of man and society share common errors from a Biblical perspective. First, they view man solely as a socially determined object. The behaviorists view man as completely determined by his environment; the functionalists view man as determined by societal roles, psychological principles, and a shared symbolic system. According to the behaviorists the concepts of human freedom and choice are an illusion; the functionalists view man as a seeker of goals determined by society. Both fall short of a Biblical view of man as a goal-chooser. Both views are also sterile in their attempt to explain human alienation, conflict, and individual struggle. Since man is not seen in his unique humanness as having an identity distinct from society, the problems of alienation, exploitation, and human conflict are seen as merely reflections of malfunctions in the environment or social system. Although much more could be said of the variance between the positivistic models and a Biblical view of man, in short: (1) they fail to conceive of man as a self-conscious being who is capable of goal-choosing activity; and (2) they fail to account for man's ability to do evil as well as good.

Phenomenological Models

A wave of phenomenologically and existentially based models of man and society have emerged in the past decade. These models are largely a reaction to the dehumanizing effects of the positivistically based models. Rather than focusing on man as an object for consciousness, they emphasize the intentionality of individual consciousness by focusing on the individual as the creator of meaning in a meaningless world. These phenomenological models include labelling theory (Howard Becker), ethnomethodology (Harold Garfinkle), the sociology of the absurd (Lynam and Scott), the reality constructionists (Berger and Luckman), and the neo-symbolic interactionists (Irving Goffman).

These phenomenological models make some valuable contributions to an adequate model of man and society. They deal with man as man, a subjective being who behaves meaningfully. They do not view man as completely socially determined, but emphasize man's creativity in the social situation. They also view conflict and alienation as prevalent processes.

However, these models also share some fundamental weaknesses which make them at odds with a Biblical view of man. *First*, man's nature is viewed as a social construction. No ahistorical human nature is posited. Man is free to define and redefine his nature with no limits. A Biblical view sees man as created in the image of God and thus having certain intrinsic characteristics which limit his behavior whether recognized or not. Human beings in other words are not the sole producers of their natures. Even the process of self-determination is carried out within a medium with its own structure. *Second*, all systems of belief are considered to be arbitrary and socially constructed. In dissolving the Kantian dilemma of things-in-themselves and things-for-consciousness, phenomenologists focus entirely on things-for-consciousness and deny the independence of the created world.

Objects are not the sole product of symbolic interaction as these phenomenologists contend, for even symbolic interaction itself depends upon certain criteria of meaningful cognitive activity. There are certain rules which must be followed for any discourse to be meaningful, e.g., the law of non-contradition. As a result of these weaknesses, the phenomenological models are guilty of having lapsed into an overly subjectivistic position. By viewing all knowledge in the social world (that of the sociologists included) as merely one arbitrary perspective, the phenomenologists have substituted "perspective" for knowledge.

Conflict Models

Most conflict models of society are but a little less positivistic than behaviorism or functionalism. However, because they stress conflict, the complete antithesis of social integration, they deserve to be discussed separately.

There are presently two dominant conflict models of society: (1) the dialectical conflict model, which was inspired by Karl Marx; and (2) the conflict functionalism model, which was inspired by Georg Simmel (Turner 1974:90-91). Marx was an economic determinist who saw conflict as inevitably arising within an economic system which propitiates an unequal distribution of goods. Conflict in economic interests continues to be the explanatory springboard from which contemporary Marxist sociologists begin their analysis of society. Although Simmel, like Marx, viewed conflict as inevitable in society, he "viewed conflict as a reflection of more than just conflict of interest, but also of those arising from hostile instincts" (Turner 1974:84). Turner states that "Simmel postulated an innate 'hostile impulse' or 'need for *hating* and *fighting*' among the units of organic wholes, although the instinct was mixed with others for love and affection and was circumscribed by the force of social relationship" (84). Simmel's conflict model of society is built upon a view of man which is very consistent with a Biblical view of

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man. However, the leading contemporary proponent of conflict functionalism, Lewis Coser, sees the source of conflict as lying "in the unequal distribution of rewards and in the dissatisfaction of the deprived with such distribution" (Turner 1974:110-111).

Contemporary conflict models, whether in the Marxian or Simmelian tradition, or some combination of each, fail to suggest that the source of social conflict may in part reside within the nature of man himself. There are contemporary Marxist sociologists who do recognize that man is more than just a reflection of society. However, it is interesting to note that when one self avowed Marxist, Richard Lichtman, argues that although the self is social, it is not *only* social, he supports this view by quoting from Simmel and not from Marx (Lichtman 1970:80). Although conflict models provide an accurate description of society, they do not usually provide an accurate *explanation* of this conflict (Heddendorf 1972).

Parenthetically, we would add that not all conflict should be thought of by Christians as bad or as resulting from man's sinfulness. We would agree with Marxists who see value in conflict, especially attempts by oppressed groups in society to better their situations.

Symbolic Interactionist Models

Symbolic interactionism stresses that the world of man's experience consists of objects, where objects obtain meaning imputed through the process of human social interaction. An individual also gains a view of himself or his "self" as an object as he interacts with others. Thus reality is socially constructed in the process of social interaction, and what is real to the individual *is* real because it is real in its effect upon him. Society can exist and social organization is made possible because people share a common symbolically constructed view of reality.

On the one hand symbolic interaction has been criticized as being merely a social behavioristic orientation which provides a positivistic model of society (Lichtman 1970; Fichter 1974), and on the other, as an orientation which views society as consisting of indeterminate actors who are "creative" and "spontaneous" (Turner 1974). Lichtman and Fichter both believe that the principal contributor to symbolic interaction, George Herbert Mead, taught a social behaviorism in which man was explained as merely being a product of society. As Lichtman states, "For Mead too, the self disappears. This may be vigorously denied but the truth is that the self as a self-conscious subject of its own existence is dissolved in Mead's extreme social behaviorism." Fichter (1972:113), states that "it remained for George Herbert Mead to destroy that distinction . . . (the distinction between individual and social aspects of human beings) . . . and to hypothesize (Strauss, 1956:204) that there is only the social self which is 'essentially a social structure and it arises in social experience.' " However, these criticisms of Mead should be balanced by Turner's (1974:180) more generous assessment of contemporary symbolic interactionism. Turner (1974:180) believes that symbolic interactionism makes the following three assumptions about the nature of man: "(1) Humans have the capacity to view themselves as objects and to insert any object into an interaction situation. (2) Human actors are therefore not pushed and pulled around by social and psychological forces, but are active creators of the world to which they respond. (3) Thus, interaction and emergent patterns of social organization can only be understood by focusing on the capacities of individuals to create symbolically the world of objects to which they respond." Most contemporary symbolic interactionists probably view the self as a product of society, but man as a possessor of a human self which is indeterminant and can act creatively or spontaneously once it has been socially produced.

Elements of An Adequate Model of Society

The main purpose of this paper has been to critically examine the major existing models of society in the light of a Biblical view of the nature of man and society. All of the examined models have been found wanting in one respect or another. To attempt to construct a "Biblical" or "Christian" model of society is not only beyond the limits of this paper, but it is also an undertaking which would deservingly be suspected by both secular sociologists and Christian theologians. We would like instead to conclude more modestly by suggesting some of the elements which should be included in an adequate model of society.

To be consistent with a Biblical view of the nature of man, an adequate model of society should include at least the following elements:

(1) *Man as capable of creating symbolic meaning and thus his own view of reality.* Much of the emphasis within symbolic interaction and in certain of the phenomenological models is consistent with this statement. A symbolic interactionist model which stresses that man along with other men create symbolic meaning, is more consistent with a Biblical view of man than either a causal or functional model.

(2) *Man as not the sole producer of reality and of his own nature.* Not only do causal and functional models fall short here, but, for the most part, so do the phenomenological and symbolic interaction models. Phenomenologists view men as the sole producers of their own natures. To be sure, they do not make the same mistake as the positivists in viewing man's nature as a product of society, but they also do not view man as having an intrinsic nature which reflects, if in a fallen way, the image of God. Certain conflict theorists come close to viewing human nature as intrinsically posited. Lichtman (1970:91) states that although, "Human nature is not unchanging . . . it is false to hold that there are no lawlike connections among its aspects. . . . It is precisely because there is a lawlike connection among aspects of human activity that any kind of foresight and planning, including socialist planning, is possible." Whereas Christians and Marxists may agree on such things as the existence of an intrinsic human nature or an inevitable eschatology, the *content* of such beliefs are vastly different.

(3) *Man as free to distort reality.* The Marxist conflict model is in obvious agreement with this statement, as capitalistic and other polarizing economic systems are seen as creating a "false" consciousness or reality. Within the phenomenological model there is no reality to distort; rather, man is "free" to create his own reality. The inadequacy of the positivistic models usually results in reality being defined in cultural relativistic terms. Reality is seen as a product of society; the individual can "distort reality" or "be out of touch with reality" only in the sense that he does not share "reality" as it is defined by society.

In regards to the "free" in this statement, while phenomenologists do view man as free (more free to create than to distort reality), positivists would offer an environmental explanation for a person's distorting of societal defined reality. An adequate model of society would posit an actual reality which man could distort because of his existing in a state of separation or alienation from the God who created that reality.

(4) *Man as partially motivated by selfish interests.* It is at this point that all of the models appear to fall short. While it is true that conflict theory does stress the inevitability of conflict which arises in society, it does not offer an at all clear explanation of the conflict arising out of the motivational aspects of man. In an excellent article on the concept of man in social science, Fichter (1972:117) states that, "As far as I can discover, sociologists have no model to explain that man can do evil as well as good." Fichter continues to observe that although this is viewed as a weakness by Dennis Wrong in his own classic article of "the oversociologized view of man," Wrong himself offers no alternative model of the nature of man. The model of society which takes into account the fact that man can be motivated by intrinsic selfish interests has not been constructed.

(5) *Man as capable of justifying his selfish behavior on the basis of his definition of reality.* Man is not only capable of selfishly motivational behavior, but he is also capable of defining reality in such a way that he does not interpret selfish behavior as selfish. Most of the models take into account man's ability to structure reality so as to justify behavior. As discussed under point four, however, most models fail to view man as the initiator of this selfish behavior.

In summary, an adequate model of society must understand man as in need of interdependence through shared meaning, while at the same time accounting for the pervasiveness of group conflict. Such a model of society would be consistent with a Biblical view of man and with the way men interact in society.

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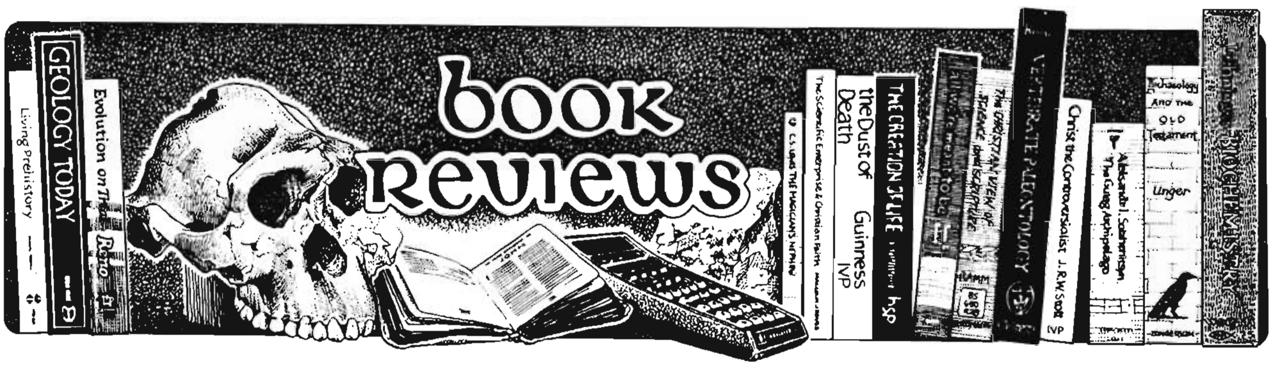

POLITICS: A CASE FOR CHRISTIAN ACTION

by Robert D. Linder and Richard V. Pierard, Downers Grove, Illinois: Inter Varsity Press, 1973, 155 pp., $1.75.

Is there any doubt that Christians are supposed to be of significant assistance to both Christians and not? No. The Scriptural records are full of items such as the second of the great commandments, the miracles of Christ, the parable of the Good Samaritan, and the like. Why then a book with this title? To argue for a specific kind of activity, not to argue for aid in general. The authors are correct in believing that a case for political involvement does indeed need to be made. In this respect, however, they do not take their task seriously enough. All too often the contents are more of an exhortation to participate in a certain kind of activity instead of a case for that activity.

By "politics" Linder and Pierard mean "the formation and implementation of public policy for the public good." In theory this can be done by state or private agencies. The emphasis upon private activity is microscopic, however. "Politics" is the realm of winning elections, passing laws, waging war and peace, and so on.

The position of Linder and Pierard is that political action and Christianity are not contradictory (chap. 1); that although a number of objections to political activity by Christians have been raised, they are of little merit and, in fact, God has ordained the state and by implication some types of political activity (chap. 2); that there are some solid Christians around who are very political (chap. 3); that college campuses are important politically (chap. 4); and that history exhibits a number of cases where the efforts of a single person or small group of people did mighty things (chap. 5). Chapter 6 is both a summary and a further exhortation.

It ought to be apparent that only the first two chapters make any sort of case for a certain kind of Christian action, and it is difficult to evaluate this case. On the one hand, some of their treatments are quite good, e.g., the short section on "submission" to governments. But underlying it all is the position that the "base" from which they proceed is that the state is a "divinely ordained institution" and its corrollary that "political involvement means active participation in the life of the state." If one accepts this starting place their case is brief but not too bad. But it seems that a case for something ought to evaluate fundamental assumptions like this one. Linder and Pierard apparently feel no such need and are unabashed statists throughout. This is unfortunate because their contentions about the legitimacy of the state can be unproblematically denied without sacrificing a shred of orthodox Christianity and perhaps even strengthening its theology in the process. It is not necessary that a majority opinion favors this alternative approach.. It is only necessary that such be possible and not altogether implausible. Since this is true, its omission is a serious flaw.

Questioning the legitimacy of the state is not far-fetched. In my experience with Christian college students, the ones for whom the volume is written, it comes up with surprising frequency, albeit usually in a rather roundabout fashion. Is it merely ironic, an historical accident or a irrelevant matter of fact that the cataclysms which Linder and Pierard call "the cosmic issues of our time" have been in great measure caused and perpetuated by the state? Could there not be, in fact, is there not evidence for, something intrinsic in the state that tends, as Friedrich Hayek says, to make the worst get on top?

It would be unfair for a reviewer to lament that a book did not say what he wants. In this volume, however, we are promised a case for Christian action but are not given an enormously helpful one.

Reviewed by Allen J. Harder, Assistant Professor of Philosophy, Iowa State University, Ames, Iowa.

Books Received and Available for Review

(Please contact the Book Review Editor if you would like to review one of these books.)

Guiness, Os, *In Two Minds: The Dilemma of Doubt and How to Resolve it,* IVP, 1976

Lewis, G. R., *Testing Christianity's Truth Claims: Approaches to Christian Apologetics,* Moody, 1976

Morris, H. M., *The Genesis Record,* Baker, 1976

Morris, T. V., *Francis Schaeffer's Apologetics: A Critique,* Moody, 1976

GENETIC FIX by Amitai Etzioni, Macmillan, New York, 1973. 276 pp. $7.95.

Etzioni's name is probably familiar to many readers because he is a prominent sociologist, because of the name itself (II Kings 14,25; Jonah 1:1), which sticks in the mind better than, say, John Smith's, and because he served on the editorial board of *Science* for several years. *Genetic Fix* is a personal book, with considerable moral implications, by this prominent social scientist.

If you read scientific book review columns with any frequency, you could probably write an acceptable review of most symposium publications without reading them. You would include complaints about the lack of unity, mourn that the extremely interesting discussion was not reported, criticize the system for publishing the book after it is badly dated, and perhaps despair that book prices have become so high. In general, if you would report the opposite of these four elements, you would have written an acceptable review of *Genetic Fix*. Whatever that title suggests to you (and the title is my biggest complaint about the book), this is a unified, inexpensive record of a symposium whose topics are still relevant. It dwells on the discussion as much or more as it does on the papers, being a sort of diary of Etzioni's stream of consciousness.

The symposium was held in Paris, apparently in September 1972, under the auspices of the Council for International Organizations of Medical Sciences, an arm of WHO. Its overall topic is approximately, "Is progress in biological and medical research good for us?". A parallel is drawn to the dilemma of what to do with knowledge in nuclear physics. As Etzioni puts it, "Can we edit progress?" (p. 29) Not stop it, but edit it.

The issues raised are many. They include reference to some agonizing dilemmas thrust upon us by the advance of science, and *Genetic Fix* would be worthy of reading for its coverage of them. These dilemmas are important, and not only to those involved, but Etzioni has bigger fish to fry. His basic concerns are two: Individual patient rights and responsibilities, and the establishment of some sort of commission to deal with the dilemmas, rather than leaving them to individual doctors and patients to worry about alone.

Concerning the first major issue, I quote:

> It seems clearly desirable that when a person's blood is tested . . . it should also be determined whether he or she could serve as a potential organ, blood, or bone-marrow donor. . . . At the same time to inform everyone whose blood was typed that he or she might be called upon one day to donate this or that, would put on hundreds of thousands of people an extra psychological burden. . . . On the face of it, the answer seems obvious: Why not wait until an actual need for a decision to donate has arisen before informing them? . . . [This] is a highly paternalistic and patronizing view. People are seen as immature children to be protected by the doctors who know better and will make the "tough" decisions for them. . . . Why shouldn't people think—yes, even worry—about these matters? Isn't it at least as worthy a topic as any they would think about otherwise? (pp. 151-152.)

Although *Genetic Fix* is not an especially religious book (Jurgen Moltmann was at the conference) it certainly concerns ethics, and has a high moral tone. The participants, including Etzioni, seem to have a strong sense of right and wrong. The book has several valuable appendices, is indexed, and is full of interesting information (such as that women who have an abortion are much more likely to have a premature baby). I recommend it.

Reviewed by Martin LaBar, Central Wesleyan College, Central, South Carolina 29630.

THE TRUTH: GOD OR EVOLUTION? by Marshall and Sandra Hall. Craig Press, Nutley: (1974) 186 pages. $2.95

To the making of anti-evolutionary books, there would appear to be no end. There must surely be more than a grain of truth in this statement, and I was forcibly reminded of it when reading this book by Marshall and Sandra Hall. I am not implying, however, that their book is quite like the whole host of other anti-evolutionary books. While their arguments are well-known, the fiery, polemical style and the repeated claim that evolutionary thinking lies at the root of all society's problems set this book apart.

The authors see evolution in very clear, black and white terms. Of the numerous possible illustrations of this, let me quote just two: "The purpose of this book is to make it *impossible for anyone to say that there is scientific proof of evolution.*" And again, evolutionists "must assume everything happened in ways that go against *all* the scientific evidence and laws of probability." And so the "scientific evidence against evolution" is presented in this vein, the evidence being thrown at the reader who is given no opportunity to reach his own conclusions. These too, are thrown at him.

The ground covered—spontaneous generation, mutations, natural selection etc.—is familiar, and as the arguments for and against have been repeated on countless occasions I will not add to the list. What does deserve comment however, is the presentation, depending as it does to a large extent on ridicule. I am far from clear who is supposed to be convinced by this—certainly not thought-through evolutionists. I was also left wondering how Christians would respond to a similarly phrased attack on Christianity. I imagine they would ignore it; failing that, they would almost certainly consider it biased, unrepresentative and unfair.

Having robbed evolution of its credence, the Halls proceed to prove the reality of special design and creation. As they themselves say, "One reality . . . is that there have been and are now only two theories of how man got here, Evolution and Creation. When one is *proven* false—ludicrously false—then the other is ipso facto *proven* true!" How do we know that special creation is true? The answer, according to the Halls, is because it can be shown to be true by "logic and science." The logic and science adopted by them consists of a mixture of 18th century-type arguments from design, further ridicule and misinterpretation of evolutionary ideas and somewhat irrelevant stories.

Apart from these particular arguments, we are left with the issue of whether the approach adopted by the authors is an essentially Christian one. My own impression is that the concept of special creation as employed in this book owes more to philosophical than to biblical thinking. As such, this does not constitute a serious analysis of creationism. What is more, while most Christians today are probably aware of the dangers of unbridled evolutionary thinking, relatively few are awake to the dangers of unbridled anti-evolutionary feelings.

An example of what I mean by the latter is provided by the last section of this book in which evolution is seen as the principle (? the only) culprit behind the loss of discipline in the classroom, most current psychological concepts and Marxism. The demise of evolution is envisaged and with it the demise of materialism, Marxism and all the other obnoxious 'isms' that assail us. Not only this, it is now possible—we are told—to *prove* the existence of a Creator. But is evolutionary thinking quite the culprit it is made out to be? Are new horizons for mankind just around the corner, once evolution has become a foible of history? Is this diagnosis in accord with the biblical diagnosis of man? Isn't the autonomy of man rather wider than evolutionary theory? And isn't the authors' desire to prove God simply a facet of man's desire for autonomy?

We need to ask ourselves whether our obsession with disproving evolution is not blinding us to far more important biblical realities. I am not suggesting that we calmly accept the tenets of evolutionary philosophy, but I am pleading that we take seriously both biblical and scientific data—difficult as these sometimes are to interpret and even more difficult to hold together in harmony.

Reviewed by D. Gareth Jones, Department of Anatomy and Human Biology, University of Western Australia, Nedlands, West Australia.

THE BIOLOGY OF THE TEN COMMANDMENTS by Wolfang Wickler. McGraw-Hill, 1972, 198 pp. $6.95

This is a translation of a unique German book, containing many interesting insights. Wickler has an hubristic view of the role of the ethologist: "Ethical claims which are not based on concrete biological data are meaningless." (p. 2); ". . . criticism of social norms . . . is a job that specifically belongs to the ethologist. His long-term goal, let us say, is to test ethical norms against natural laws . . ." (p. 21). He does recognize that certain social norms, such as the Christian commandment of love, go beyond natural laws (by which he means laws controlling animals), but thinks that such commandments should be justifiable on the basis of natural laws. If not, then ". . . strickly speaking- [they] should not be followed." (p. 22)

In spite of this view, which would seem to make moral philosophers, legislators, parents, etc., answerable to ethologists, Wickler confines himself to an attempt to discover how animals obey the commandments, rather than prescribing how humans should act. Wickler does not deal with the first few commandments, since they are not directly related to social behavior.

The author finds examples of not killing, not committing adultery, not stealing, not bearing false witness, not coveting, and honoring elders in various kinds of animals. He also examines parallels to the Ten Commandments in non-Jewish societies. These chapters are the bulk of the book, and very interesting. Among the highlights:

A close Masai parallel to the "cultic decalogue" of Ex. 34:10-26.

An attack on Kant's categorical imperative.

Wickler's statement that the best way to compare human and animal behavior is to study animals occupying ecological niches similar to man, rather than to compare man with the higher primates.

"It can be no surprise to the ethologist that the biblical term for the most intimate marital relationship between partners is 'knowledge'." (p. 132.)

"Abortion cannot be justified either economically . . . or ethically." (p. 140.)

A German survey (1970) found that 77% felt cruelty to animals should be punished, but only 61% felt that beating one's wife should.

An attack on situational ethics.

Examples of lying and of "false witness" in animals.

I found the logic of Wickler's discussion on killing to be weak. He says that there is an inhibition against killing in animals, and that since this is so, overcoming that inhibition is a symptom of rationality. If that is rationality, I hope it's not contagious. Another negative criticism is that the author generally takes a low view of Scripture.

This is an interesting book, of some value to psychologists, sociologists, theologians and ethologists.

Reviewed by Martin LaBar, Central Wesleyan College, Central, South Carolina 29630.

THE ASTRAL JOURNEY by Herbert B. Greenhouse, New York: Doubleday and Company, 1975, 359 pp., $8.95.

This book is typical of the pseudo-scientific books which are good sellers just now. It seeks to appear religious as well as scientific. The thesis is that each person has a "second body," "double," "soul body," or "astral body." This "astral body" can sometimes leave the physical body and travel long distances, though it is attached to the physical body by a silver cord. Such "astral journeys" usually take place in sleep, but some claim to make them at will. LSD and alcohol have assisted some such trips (pp. 102 ff.).

Greenhouse tells hundreds of stories of "astral journeys." Some are from ancient or medieval sources. Some are taken from fiction. Satisfactory documentation is never offered. Even in the section, "The Scientific Approach" (pp. 269-324), there is no description of evidence obtained under scientifically controlled conditions. Yet there is an obvious attempt to make all this credible.

The use made of Bible stories illustrates the way Greenhouse handles his sources. He declares that Elisha travelled in his astral body to learn Syrian military secrets. Paul made an astral journey to heaven. And the resurrection of Jesus was really his astral body (p. 21)! Such use of the Bible makes nonsense of it. It is quite similar to that in *Chariots of the Gods?*, and such books.

Greenhouse writes as one who believes. And because he believes, some of his readers will believe—though not because of convincing evidence.

Reviewed by Kenneth E. Jones, Professor of Theology, Gulf Coast Bible College, Houston, Texas 77008.

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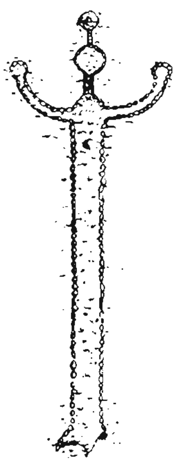

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