Seeing Together — The Seen and the Unseen

Robert L. Wixom

The 1983 Jonathan Plummer Lecture
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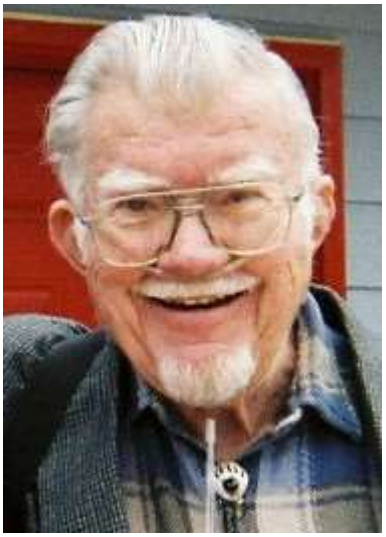


Dedicated to JEANNE F. WIXOM

Who left many loving memories, and

Who passed on to another world on

October 14, 1983

Biography of Robert L. Wixom

Although Bob is a birthright Friend, the evidence suggests that he is a convinced Friend. Born of Quaker parents, they and the siblings were nurtured by Germantown Monthly Meeting, Philadelphia Yearly Meeting. His education was at Oakwood (Friends) School and Earlham College. His Earlham education was interrupted by a World War II interlude in Civilian Public Service as a human guinea pig in malaria drug experiments; these experiences introduced him to biochemistry. Attending postwar Earlham led to meeting Edith Ann Smith and their subsequent 1949 marriage. Graduate studies took them to the University of Illinois. During the 1952-1964 years, Bob was on the biochemistry faculty of the University of Arkansas School of Medicine. They shared with others the initiation of Little Rock Friends Meeting and development of a series of work camps and programs related to desegregation. Sons David and Richard arrived. The family moved to Columbia, Missouri, for Bob to serve on the biochemistry faculty of the University of Missouri School of Medicine. They shared in the 1967 formation of Columbia Monthly Meeting, part of Illinois Yearly Meeting. Edith died of cancer in 1967.

Bob has been Clerk of Columbia Monthly Meeting and Illinois Yearly Meeting (1971-1974). Attendance at an Earlham meeting of Friends General Conference led to meeting Jeanne H. Forest and their later 1975 marriage. Jeanne, Bob and stepson, David, were active in a variety of Friends activities; Jeanne's comments are included in the text of the Plummer lecture. Unfortunately Jeanne's cancer reappeared in July 1983 and she passed away in October 1983. The roots of Bob's message may be found among the above deep personal, spiritual and professional experiences.

Seeing Together — The Seen and the Unseen

We have gathered together again for Divine worship and friendly sharing. We have been called to return to this place — our spiritual home. We feel drawn to search with kindred souls for the Light Within that leads to inspiration, guidance and strength.

Our theme this year is: "Consider the lilies of the field how they grow; they neither toil nor spin; yet I tell you even Solomon in all his glory was not arrayed like one of these…" (Matthew 6:20, Luke 12:27) This passage is preceded by, "Therefore I tell you, do not be anxious about your life, what you shall eat or what you shall drink, nor about your body, what you shall put on. Is not life more than food and the body more than clothing?" (Matthew 7:9). Anxiety and worry over some possible development seems to be a part of our modern "civilized" life. However, Jesus emphasizes the Jewish faith that man has a unity of many parts, all of which draw upon the soul which has no existence apart from the body; anxious care of one's physical size or the length of one's life is in Jesus' view a futile exercise. As we shall see, God does make provision for our lives.

While preparing this presentation, I wanted to try to achieve inspiration by using the combined resources of the spoken word and art. In that mood we will continue this morning with photographs for key phrases. (The written version will delete some of these phrases along with all of the colored slides.) One of our friends who has lived many years in Israel described the lilies of her beloved country as "frequently white, lavender, yellow and many other colors; shorter in stature than our lilies, and

growing wildly in scattered fields and along roadsides in Galilee. They are prolific and spectacular." Our common day lilies stand tall with their rich orange-red petals; they grow in waving clusters, and are very sturdy. However, that is only part of the reason for my passion for lilies. The lilies in the side yard of our home have a long history. My Mother planted them in her backyard garden in our Philadelphia home in the 1930's. When the family moved to New Jersey in 1947, they were also transferred, replanted and multiplied. They survived another family move in New Jersey and then a move to our home in Little Rock, AK. After my Mother's death, they took on a new significance. In 1964 we brought the bulbs to Columbia, MO. Then another move followed. These five moves demonstrate not only the power of the plants' genes to control growth and reproduction, but also symbolize the continuity and strength of my, or most any Mother's love for the precious lives in her growing family. When a Mother's love is that strong, God's love for us must be even more persistent. I will continue, for good reasons, to love lilies.

The Gift of Sight

To develop my theme on Seeing, let us move to other pictures of: Queen Anne's lace along the roadside, phlox by the banks of an Ozark float stream, dogwood in an early Missouri spring, shrimp plant at the edge of a creek, milkweed blowing in the wind and water lilies on Quetico-Superior lake. Whether these precise wildflower photographs are seen or not, each of us has an inner reception for enjoying the beauty of nature. Biochemically, seeing is the impinging of light waves on the rods and cones of the retina, the reception therein of light of different wave lengths by chemical compounds closely related to vitamin A, and the conversion of this light energy to a nerve impulse that travels to the brain. Can we "see" beyond or without the above steps in the visual process? How far away can we see distant objects? What is the smallest object we can see? What spiritual insight do we gain from what we see? We will return to some of these questions.

Some or many here share my calling to climb mountains. One outstanding climb that I like to recall was with a group of Quakers that climbed together Long's Peak (14,400 ft. in the Rocky Mountain National Park). We enjoyed the forest canopy at the foothills, the turbulence at the timber line, the wildflowers in the tundra above, and the exhilaration and comradeship throughout. Aching muscles were forgotten at the peak in the oneness of being in and surrounded by God's great beautiful planet. An invading sense of awe reminded us then and now that the Psalmists wrote over and over about a rock, a fortress, a hill: "The earth is the Lord's and the fullness thereof; the world and they that dwell therein … Who shall ascend unto the hill of the Lord? Or who shall stand in his holy place? He that hath clean hands and a pure heart, who hath not lifted up his soul unto vanity, nor sworn deceitfully" (Psalm 24). We all know and love the 121st Psalm, "I will lift mine eyes unto the hills, from whence cometh my help. My help cometh from the Lord which made heaven and earth … The Lord is thy Keeper; the Lord is thy shade upon thy right hand."

The words of the poets provide a visible picture, but suggest a partially hidden meaning beyond that visible to the eye. A poem cited by William J. Reagan, long time principal of Oakwood Friends School (1916-1948), illustrates the point:

Peace

Not the peace of a stagnant pool
But of deep water, flowing, water quiet and cool.

Poise

Not the poise of a sheltered tree,
But of an oak, deeply rooted, storm strengthened and free.

Power

Not the power of fisted might,
But of the quickened seed, stretching toward Infinite Light.

I have been using colored slides to enhance the sense of seeing. The sense of hearing is also potent, though more difficult to portray. When we close our eyes, we would readily recognize the melodious songs of our flute players, the delightful play of our children, the hammering of a red-headed woodpecker, and the splashing of a waterfall. Touch and taste are other senses that may be cultivated and utilized to enlarge our wonder and understanding of God's world. Let us peer further.

Science, Religion and Creativity

Modern man is no longer limited by the five senses. Telescopes and accessories enable the eye to bring the farthest reaches of the universe into our awareness. Microscopes facilitate seeing the cells within our organs, the subcellular architecture of these cells, and even the appearance of the larger molecules. Appropriate amplification and transmission allow us to send the human voice to a satellite and bounce it back for the enjoyment of others. Hence, man in our era perceives with a revolutionary extent the seen and unseen world around us. Are we employing the above tools and instruments for the benefit of all men and for God's greater glory?

Today's Plummer lecture may be for some an unusual blend. Over the years, religion and science have rarely appeared in the same lecture, same book or same mood. For me, they should. I hope sharing some insights will persuade you. Some view the scientist as the man in the white coat, heating test tubes, pumping gases around tubes, pushing buttons on complex instruments, presenting semi-intelligible long talks at scientific meetings, etc. Some believe that religion is walking slowly within some cloistered monastery, praying precisely at set times during the day, singing rote words of praise to a distant Lord, and so on — an anachronism in today's world. Both views are misleading and false due to their concentration on exterior expressions and superficial features. Friends have long ago set aside a specific building, a stated book or a precise creed as needed for a vital religion.

What, then, are the essentials in a description? The scientist has an emphasis on thorough experiments, rigorous logic, hypotheses that endeavor to encompass facts and theories that try to stand the test of time; however, beyond these facets is a man ~~a human being with hopes, joys, sorrows, intuitive thought and, above all, a burning sense of curiosity. Why? When? What? This curiosity is partly subconscious and partly conscious in disciplined thought and an ordered sequence of laboratory steps. However, preceding conscious rational thought, curiosity drives and nurtures creativity. The intuitive grasping at relationships, at wholeness, sparks both curiosity and creativity. All three attributes facilitate originality~~ the search for new understanding, revised relationships and constructive imagination. Each phase of creativity is fueled by quiet meditation, freedom from distractions, some persistence, an observing outlook, a preparation throughout life, a sensitivity and open-mindedness, and a liberal sprinkling of individuality. A sense of coherence and direction may grow concomitantly.

Is this description of the mental activity of scientists confined to scientists? No, as this creativity is found in the inspired, written phrases of the poets, the moving prose of the essayists and novelists, the enchanting poise of the graceful dancer, the disciplined search for truth and meaning of the philosophers, the drive for truth and right relationships of the prophets and others. Thus, before the physical appearance of the poem, painting, book, dance, prophetic message, etc., each creative person shares in those great common human bonds of curiosity, imagination and reverence. With that spirit, let us move ahead.

Astronomy and the Faraway Unseen World

Prehistoric man was fascinated and mystified by the stars. Biblical writers have also noted this vast expanse of space. When man invented the telescope in 1608-9, our power to "see" the heavens increased 33-fold. A prominent astronomer and Friend, Arthur Eddington, wrote in his 1927 Swarthmore lecture (*Science and the Unseen World*) on the beginning of the world as "… primeval chaos which time has fashioned into the universe we know. Its vastness appalls the mind; space boundless but not infinite, according to the strange doctrine of science. The world was without form and almost void."

Forty years after Arthur Eddington, our imaginations and intellectual resources, our engineering design and structural materials placed man in orbit around the earth (1961), defied gravity and circled the moon (1968), and then in 1969, men dramatically walked on the surface of the moon. Since then we have landed instrument packages on Mars and Venus and traveled to the outermost planets (Saturn). Radio telescopes allow us to study stars whose light has been traveling towards us for more than 10 billion years. A satellite containing an infrared telescope with computer processing on board was launched on January 25, 1983. Such telescopes have led to new thoughts on the nature of our universe with its billions of galaxies.

For 50 years astronomers have recognized that our universe is an expanding one ~~every part is receding from every other part. A long, long time ago, these parts were all much closer~~ probably packed into an ultradense, small clump. Our observable universe began at a finite time in the past in a hot explosion, the Big Bang.

"When time began, all mass and energy were compressed almost to infinite density and heated to trillions upon trillions of degrees. A cosmic explosion rent that featureless mass, creating a rapidly expanding fireball. It has been cooling and slowing ever since … At first the universe was an impenetrable haze. During the first million years, temperatures dropped to 3,000 degrees kelvin (3,000 degrees above absolute zero). Nuclei captured electrons, producing atoms that formed an unsettled gas of hydrogen and some helium. The universe cleared and everywhere blazed with light. Denser regions of gas, pulled together by their own gravity, resolved into stars collected in aggregations called galaxies. Today's universe continues to expand" (Gore, 1983). This instant start of creation, the Big Bang, has been estimated to have occurred from 4 to 20 billion years ago, probably about 15 billion years. Three minutes after the Big Bang, the temperature of the Universe was 70 times hotter than found in the core of the present sun. At that time, the "four basic forces of nature ~~gravity, electromagnetism, the strong atomic force and the weak atomic force~~ were unified" (Gore, 1983). All of our vast storehouse of astrophysical knowledge on galaxies, comets, novae, supernovae, neutron stars, black holes and so on seem to be consistent with the hypothesis of the Big Bang.

After the formation of the solid earth, various physical forces led to the formation of amino acids, sugars, etc. (prebiotic chemistry), and their condensation to coacervates, proteinoid microspheres and unstable living systems (Fox, 1920-80; Brooks and Shaw, 1973). The oldest living fossils, i.e., the remains of ancient bacteria and algae more than 3 billion years old have now been found in Minnesota-Canada (Gunflint formation), Africa (Fig Tree formation) and Australia (Bitter Springs formation) (Barghoorn, 1971; Brooks and Shaw, 1973; Gurin, 1980). How can we comprehend this stretch of time? If the earth's 4.5 billion years were expressed as one week, then the reign of bacteria covers five days. At 10:00 p.m. on the 6th day, the earliest invertebrates — jellyfish, sponges, sea pens, and worms arrive. By 1:30 a.m. of the 7th day, invertebrates in the sea had increased in abundance and diversity, particularly trilobites and brachiopods. At 9:00 a.m., jawed fish and small land plants had appeared. Soon the fish had adapted to land, becoming the first amphibians. By 5:00 p.m. of the 7th day, the amphibians had adapted to independence of the water and evolved into the reptiles. Each of you is aware of the giant dinosaurs and the early large birds. About 10:53 p.m., the oldest common ancestors of apes and man lived in the dense forests. Man walked on this earth about 11:57 p.m. (1-1.5 million years ago). His endeavors in art and religion began at 11:59:56 p.m. (30,000 years ago) (Gurin, 1980; Barrow and Silk, 1980). Such a sweep of time tends to defy our comprehension!

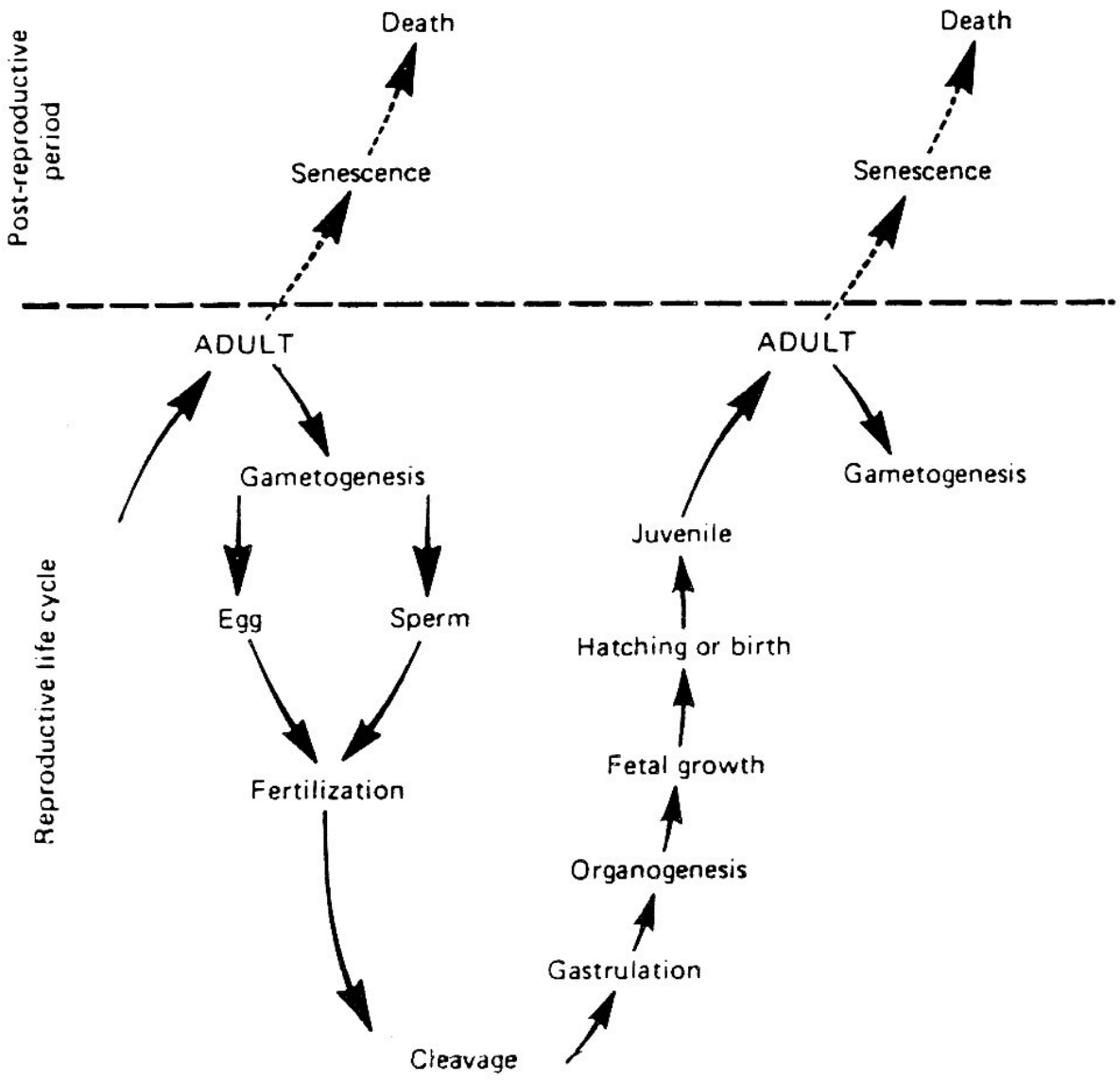
The above classical evolution of Darwin, now known as macroevolution, is complemented by the newer evidence of microevolution. Biochemists have developed potent tools to determine not only the identity of amino acids in large proteins, but the complete sequence of these amino acids in the long chain of proteins. The sequences, the microstructure, of hemoglobin from various animals may be compared, computerized, and lead to evolutionary relationships and family trees among these animals. After extending these approaches to many other proteins, these microevolution results may be compared and extend the morphological comparisons in macroevolution. Again, the tools for "seeing" lead to new dimensions of reality beyond the comprehension of sight.

Biological Sciences and the Nearby Unseen World

The invention of the microscope in the early 1600s, with a 270-fold magnification, allowed man to see another unseen world. Now powerful electron microscopes magnify by a factor of 1,000,000. An early area of study with such amplifications was embryology. Almost all higher animals begin their lives from a single cell, the fertilized ovum (zygote), which has a dual origin in the union of two gametes (a spermatozoa and an ovum). From a biochemical viewpoint, the merging of the hereditary material, DNA, from the two germ cells provides all of the genetic information for the development and maturation of the animal species through the stages depicted in the scheme:

Life Cycle of a Typical Vertebrate

Solid Arrows Indicate Continuity of Germ Plasm



From B. M. Carlson (1981), *Patten's Foundations of Embryology*

Vast stores of supporting knowledge for the repeating steps have accumulated from comparative embryology, experimental embryology, teratology, endocrinology and developmental biology (Carlson, 1981). However, the phenomena of gametogenesis, fertilization, development and maturation as a cycle continues. While the specifics of visible morphogenesis may vary, these overall patterns are valid for the birth of animals, the hatching of eggs in birds and the metamorphosis in amphibians.

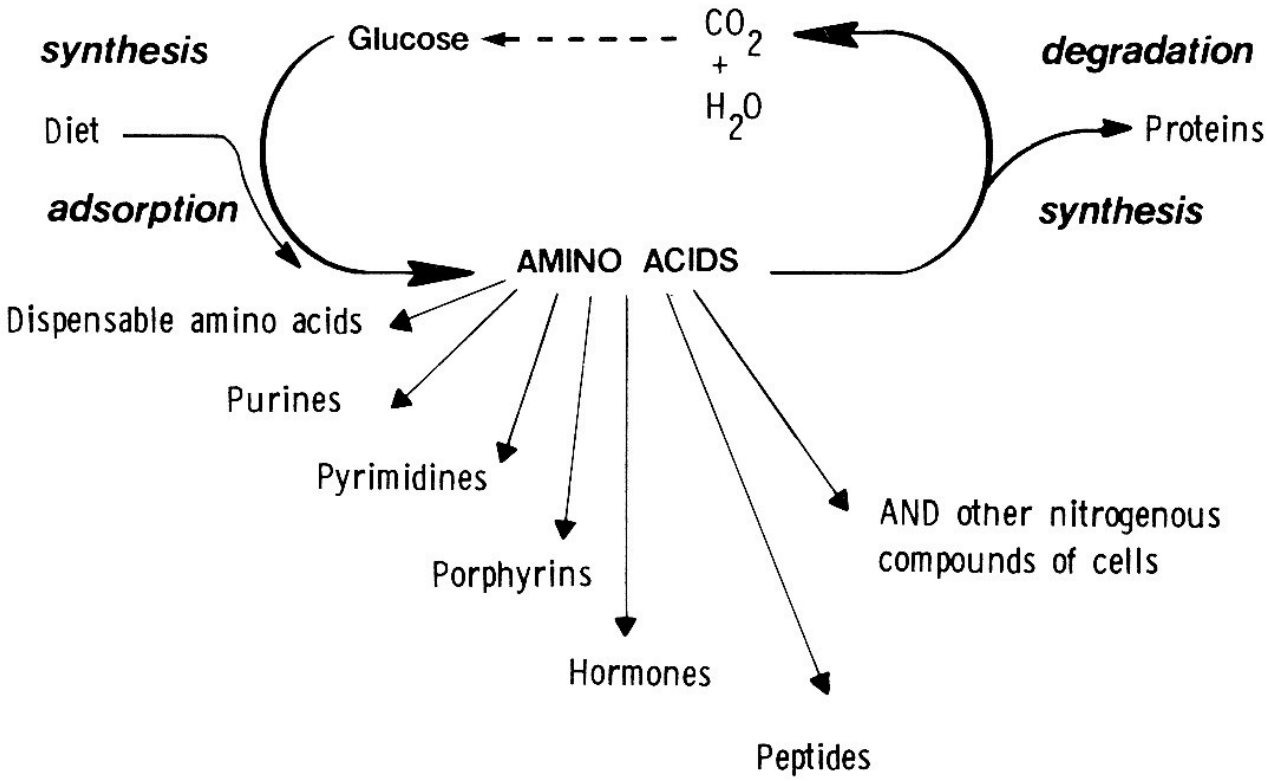
The microscopic and biochemical studies of the last 30 years have shown that while individual animal cells from diverse organs and species have some differences, their similarities are overwhelming. Almost

all possess a nucleus containing DNA and RNA, responsible for cell continuity, and a cytoplasm containing mitochondria ~~the powerhouse of the cell for oxidizing sugars and fats; the lysosomes~~ the organelles responsible for self-digestion, cell turnover and renewal; the internal membranes with their major role in protein synthesis; the soluble portion of the cell with many enzymes and a few other subcellular organelles. The reams of research articles, reviews and books condense to the above startlingly simple description. How does this view of cells and their function relate to the phenomenon of development?

Growth, Development and Patterns

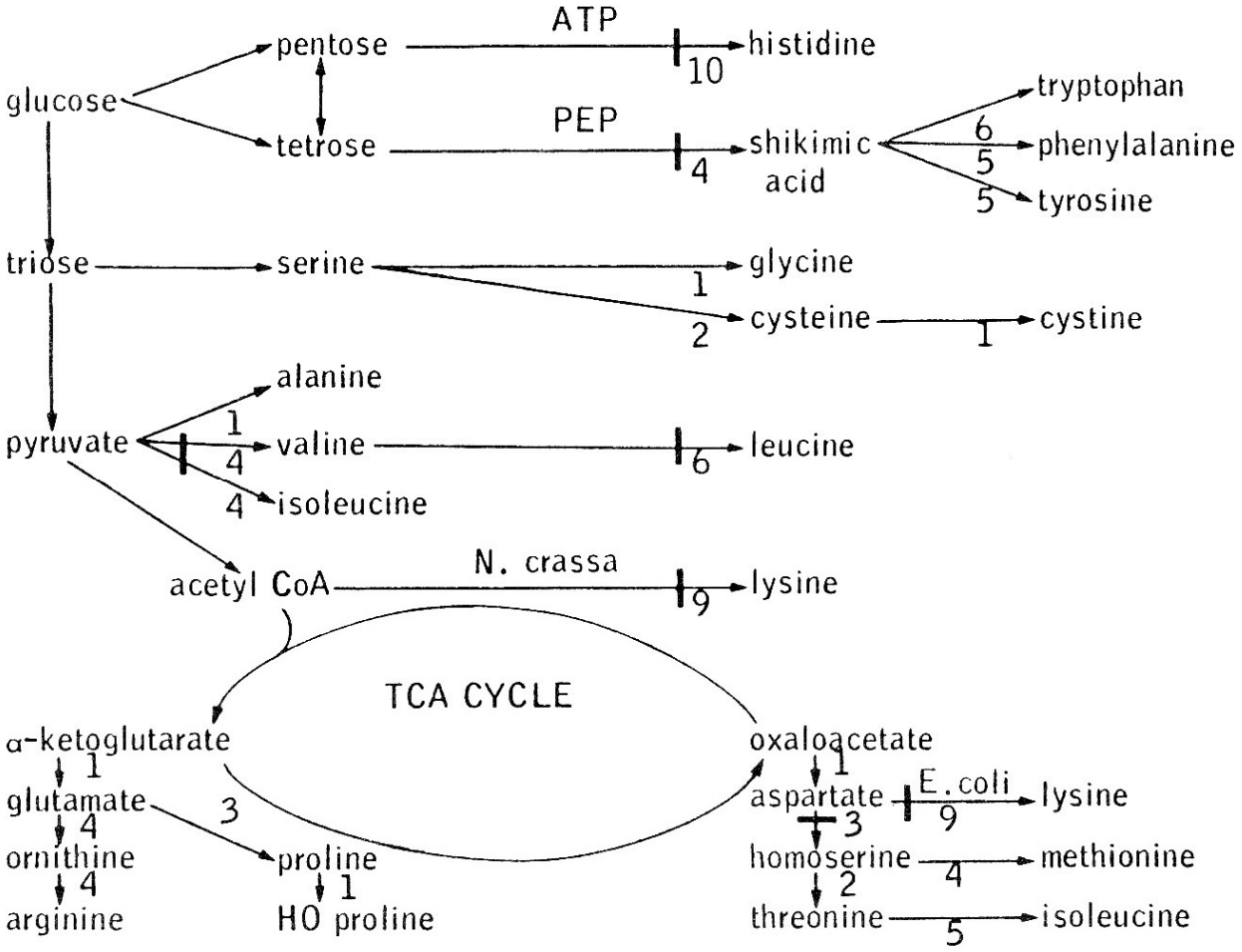
From the visible aspects of organ function, whether muscle contraction, lung movement and oxygen consumption or light reception and vision, let us examine the invisible facets of development. Each cell is involved in the synthesis of such large molecules (macro molecules) as DNA, several RNA entities, a variety of proteins, certain carbohydrates, etc. The cell machinery must synthesize or obtain from the diet the small precursor molecules in order to make the large macromolecules (see figure for details).

Amino Acid Metabolism in Animals



Biochemists have also detected a myriad of chemical pathways for synthesis — the intermediates and the catalysts (enzymes) for these reactions. The numbers herein refer to the number of enzymatic steps in the bacterial cell (see figure).

Pathways of Amino Acid Biosynthesis

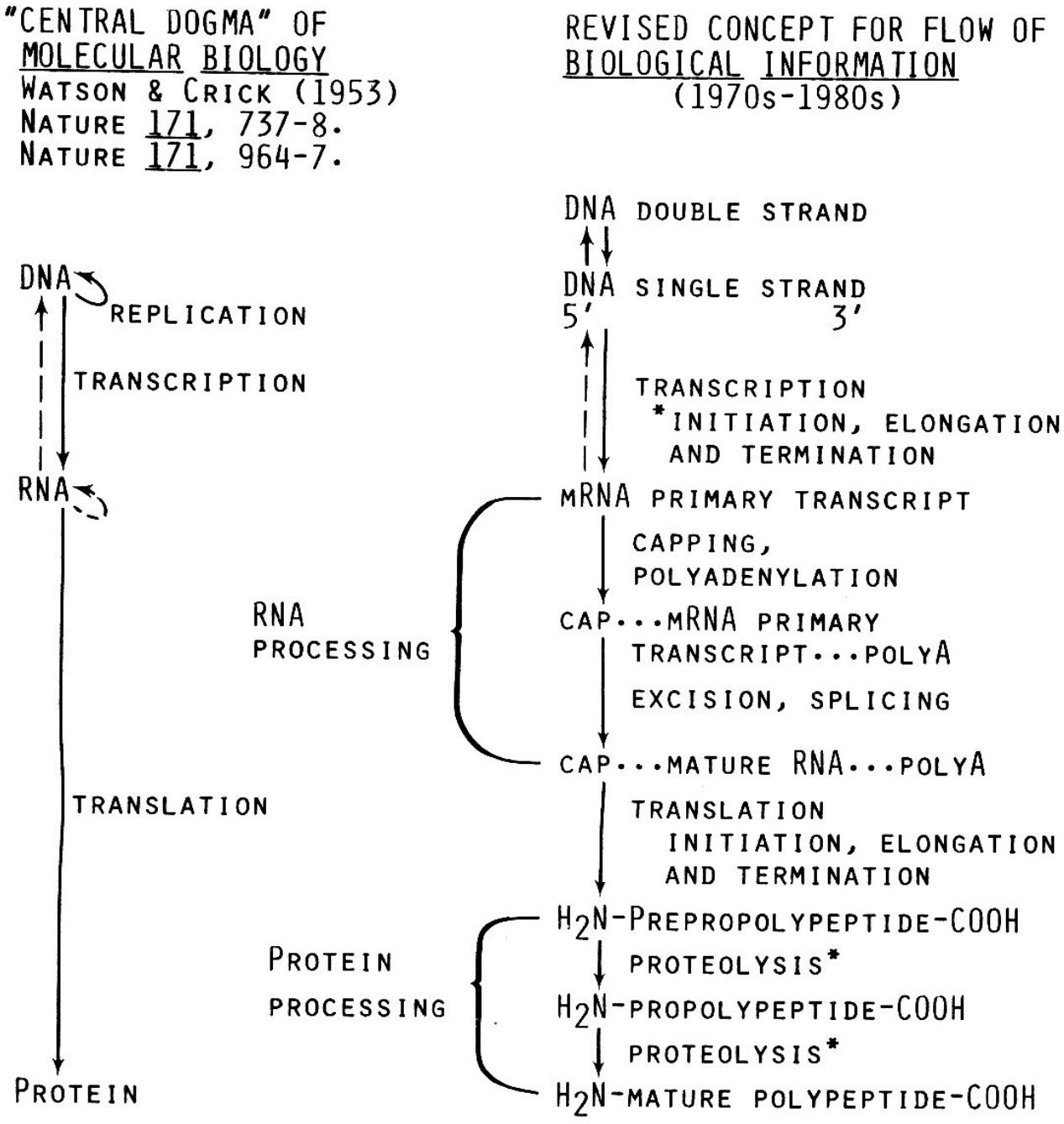


These pathways of amino acid biosynthesis may be compared to interstate highways and the flow of cars and trucks moving along these roads. We know that road construction and accidents occur in our interstate highways, leading to those long lines that bedevil our patience. However, living cells also have a complex pattern of regulation of metabolite flow (e.g. induction, repression, end product inhibition, genetic regulation structural regulation/compartmentation, etc.). Enzymes, hormones, vitamin derivatives (coenzyrnes), prostaglandins, neurotransmitters, and nerve impulses have also a regulatory role. These control processes occur frequently at the first step of a branched pathway, or may prevail at multiple sites in the pathway. These mechanisms might be compared to our red, yellow and green traffic lights, our sweeping cloverleafs to assist traffic movement at highway intersections, and our highway patrolmen to regulate automobile flow. My message is that life at the cellular level has patterns which are also regulated in intricate detail.

The synthesis of macromolecules is more complex, but the broad framework is defined in the following slide. DNA, the macromolecule containing the repeating sequence of nitrogenous bases, sugars and phosphate esters (nucleotides), has all of the genetic information. Enzymes exist that can copy the original DNA molecule, similar to a template for manufacturing multiple copies of an automobile hubcap or a fender in a factory assembly line. DNA can be copied with a change in language to form RNA with

different nitrogenous bases and sugars (the process of transcription). The RNA carries the genetic message from DNA in the cell nucleus to the protein synthetic machinery in the cell cytoplasm (ribosome) (see left side of figure). Additional enzymes change the triplet code of the nucleotide bases in RNA to allow the systematic ordered incorporation of amino acids into specific proteins (translation).

Growth of a Hypothesis



* Step (or Reaction) is more complex than shown — RLW/1983

The overall process, sometimes called the "central dogma of molecular biology," provides an amazingly accurate transfer of genetic information into specific proteins. When a rare mistake is made, the body promptly removes that protein by lysosomal action, or a hereditary disease (molecular disease), such as sickle cell anemia occurs. Such constancy ensures the continuity of tissue function, overall body composition and such higher facets as human personality.

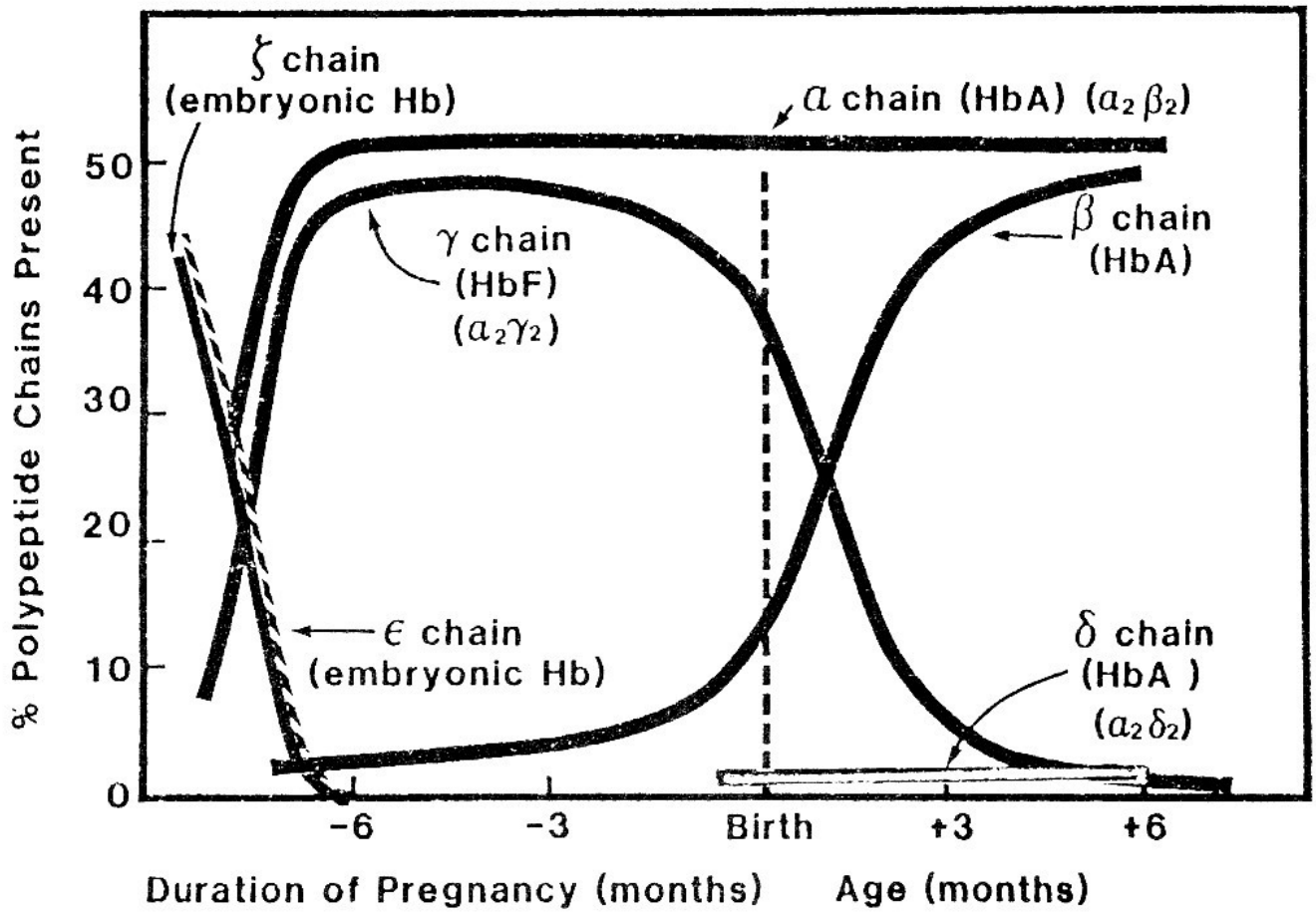
However, life is not simple; neither is science simple. The above "central dogma" has grown more complex and detailed, as shown on the right side of the figure, with the accretion of more experimental information. RNA must undergo processing by the indicated reactions. Similarly, many of the initially synthesized proteins must undergo stepwise hydrolysis reactions (as shown in proteolysis), or participate in processing in one of ten other known type reactions (not shown) to form the mature protein.

As cells divide, genes, that is the DNA in the nucleus, are turned off (repression) or on (activated or derepressed) in their expression. When the immature embryo enters the gastrulation stage, tissue specific genes become activated. Later, other genes controlling differentiation become active during organogenesis and histogenesis. Probably only 5 to 10 percent of the genes are active at various stages of development. Then developing cells become specialized by the process of differentiation. The molding of the configuration of the embryo (morphogenesis) contributes to the branching of the air pathways in the lung, the shape of the eyeball, the intricate details of a feather, the whorls on our fingertips, etc. Such evidence points to an invisible blueprint that was laid down at an earlier time.

During both fetal and postembryonic life, growth continues, but more significant than an increase in tissue mass is the disproportionate growth of body parts (differential or allometric growth). Some cells or tissues undergo a programmed cell death (involution). Other cells or tissues, when lost by accident or removal experimentally, will be replaced by the process of regeneration, but again in a controlled pattern. Over and over again, nature has presented examples of the interaction of heredity and environment in the usual pattern of development.

These morphological considerations are highlighted by describing certain biochemical facets of hemoglobin, the red protein in the red blood cells (erythrocytes) that functions in oxygen transport from the lungs to the peripheral tissues. Adult hemoglobin (HbA) has 4 iron ions, 4 complex cyclic compounds (porphyrins) and 4 peptide chains, i.e., two each of 2 different chains (α**WARNING**: Plugin disabled TAG!2β**WARNING**: Plugin disabled TAG!2). However, the human infant has fetal hemoglobin (HbF) with 2 alpha chains and 2 different gamma chains (i.e. α**WARNING**: Plugin disabled TAG!2γ**WARNING**: Plugin disabled TAG!2) (see figure).

Production of Peptide Chains of Hemoglobin



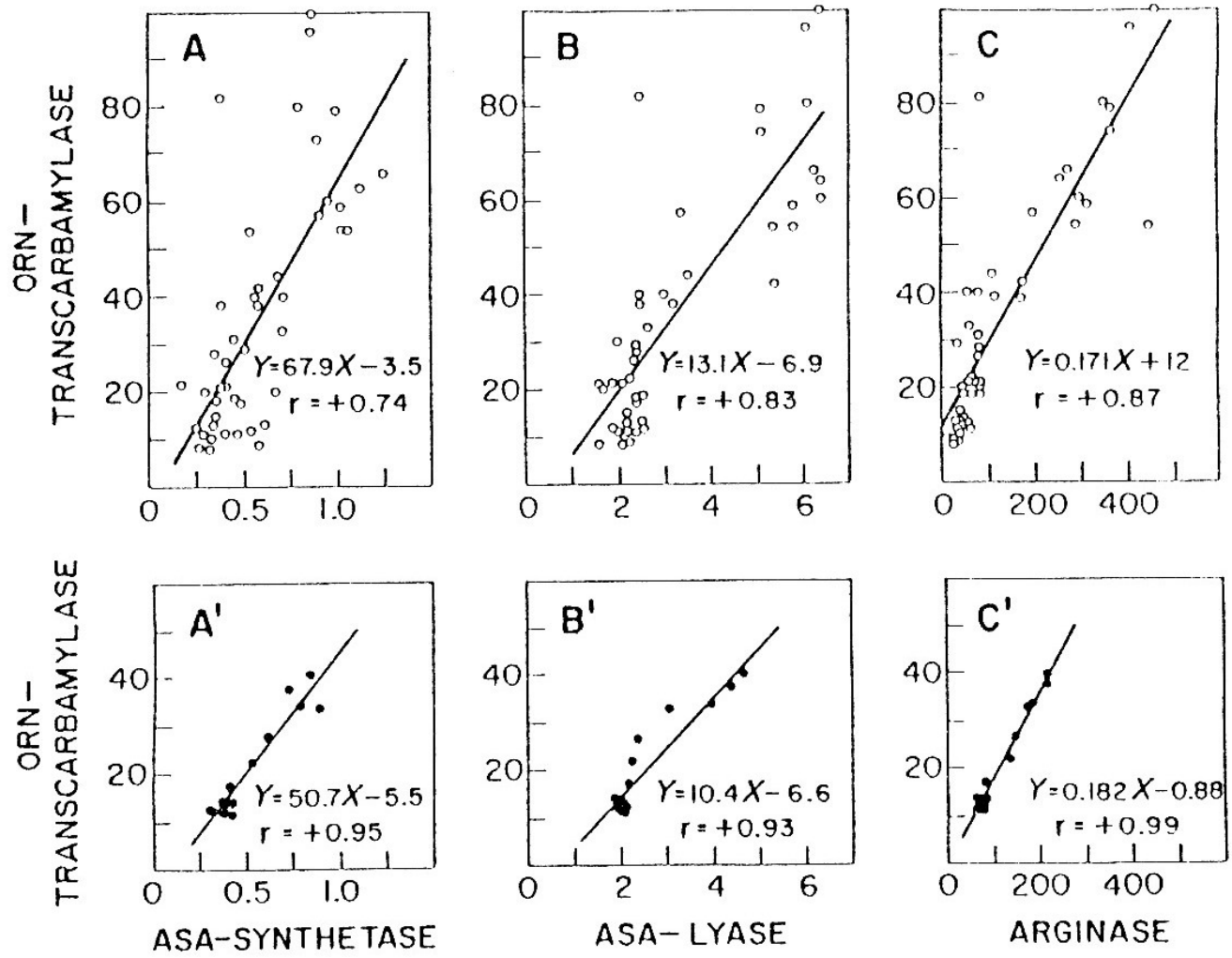
Consequently, fetal hemoglobin is synthesized by the protein synthesis machinery during late fetal life and then turns off the gamma chain synthesis by the 3rd month of post-natal life, while the alpha chain synthesis starts during embryonic life and continues throughout adult life. In early fetal life, the epsilon chain is synthesized, leading to the temporary appearance of another fetal hemoglobin. The appearance and disappearance of these specific hemoglobins is governed by the turning on and off of specific genes at stages of development. An earlier pattern or plan encoded in the nucleus (DNA) is deciphered during this example of biochemical development.

The Religious Significance of Tadpoles

Several years ago I expressed some thoughts in our Meeting for Worship on tadpoles, the immature or larval form of frogs. The following expressions were derived from a year of research in this area. All of us as children or adults have noted the clusters of frog eggs in ponds, watched the darting movement of the tadpoles and enjoyed the croaking of frogs at night on our camping trips. The development of the tadpole into a frog (metamorphosis) has been placed on a precise time scale and related to tail length. The rear limb buds appear earliest, then the rear limb develops into the foot paddle, followed by front leg development and leads to metamorphic climax, followed by resorption of the tail. Some 25 specific

substages can be delineated and are widely used. Many other organ systems also are affected in sequence: changing from the herbivorous tadpole to a carnivorous frog is accompanied by alterations in the intestine, transformation of the gills to lungs for the air environment, changes in the nature of the tadpole's hemoglobin, in the pigment of the eye's retina to facilitate light sensitivity, changes in the silvery skin of the tadpole to the green-brown of the adult frog, etc. All of these changes are promoted by minute amounts of thyroxine, the iodine-containing hormone of the thyroid gland. Each of the above changes is in preparation for the later stage of terrestrial life.

While the tadpole lives in the pond, the excretion of ammonia (ammonotelism) as the primary end product of protein metabolism is easily handled by the kidney and by dilution in the surrounding water. However, the adult frog does not have this luxury of a large volume of water. Nature has evolved a set of five liver enzymes (urea or ornithine cycle) in order to detoxify ammonia and convert it to urea, a small non-toxic, very soluble molecule. Urea is also the primary end product of protein metabolism in mammals. Hence some of our experiments showed the rise of these enzymes in the tadpole's liver prior to natural metamorphic climax. When micro concentrations of thyroxine (10**WARNING**: Plugin disabled TAG!-8 M) were used in the surrounding water, the metamorphosing tadpoles had visible changes in the legs, tail, mouth and eyes within two weeks, an acceleration of the usual summer-long process. However, shortly before these events, we found that the urea cycle enzymes increased in the tadpole's liver in a parallel pattern (Wixom et al., 1972). Then we made graphs plotting the activity of one enzyme against each of the other enzymes.



The top three graphs (A, B, and C) were derived from the tadpoles undergoing natural metamorphosis, by harvest of tadpoles over the summer; the bottom three graphs (A', B' and C') plot data from the tadpoles having the thyroxine stimulus (the two-week experiment). The numbers and equations from statistical analysis can be skipped, as the naked eye shows that each pair of top and bottom graphs have the same slope and are parallel; the high gamma values indicate an excellent correlation in each of the plots. We called this a concerted response; these biochemical changes were also a part of an orderly, patterned sequence in the developing tadpole. They occurred during metamorphosis prior to their required use in the adult, terrestrial frog and suggest a hidden pattern, i.e., the template of DNA, and the activation of genes that regulate and provide overall control of specific gene expression. What is the spiritual lesson from biological evolution or development? The answer, implicit earlier, is that the spiritual life requires also nurture, exercise, devotion, and a preparation for the next stage.

Patterns in the Life of the Spirit

Whether the illustration given is on the Big Bang, the development of this geologic world, the peak of hemoglobin, or the transformation of a tadpole, each example has the common elements of a pattern, a cause and effect, a preparation now for some future phase. Is the spiritual life any different in the need for nurture? By daily neglect, many of us proclaim an anarchy in the spiritual world. My plea today, along with many others more gifted in expression, is a call for the conscious, intentional preparation for the Life Within, the unseen, but real life.

The relatively rare mystics, earlier and present-day, remind us and call us to the life of meditation, inner devotion and prayer. We rationalize when we say the path is uncharted; the devotional classics of Thomas A. Kempis (*The Imitation of Christ*), an unknown English Carthusian monk (*The Cloud of Unknowing*), Brother Lawrence (*The Practise of the Presence of God*), Blaise Pascal (*Pensees*), William Penn (*The Fruits of Solitude*), Kahlil Gibran (*The Prophet*) and many others are readily available. Or, if one prefers a modern expression, we might select to read John Woolman (*Journal*), Rufus Jones (*A Call to What Is Vital*), Thomas Kelly (*Testament of Devotion*), Douglas Steere (*On Beginning from Within*), D. Elton Trueblood (*The Essence of Spiritual Religion*), or John Yungblut (*Discovering God Within*) and others. Prayer does not come easily, but needs preparation and a climate within one's soul. Meditation and reflection on God's beauty and love may lead us to the restoration of wonder and awe. Meditation may lead to the needed break in the affliction of our western society with busyness and anxiety. Other ways are at hand to rupture this cycle, but meditation at its best leads onward to prayer.

Prayer is the deepest feeling at the ground level of being; it may start anywhere, any level, and go on to a deeper level. Some prayers go on to a communion with God and may lead to a centeredness, a direction and an inner joy of life. Other prayers give witness to the continuous conversion of a life, the renewal of love, and a sensitizing to those in need. The life of prayer seems to go hand in hand with a tangible expression of inward growth, poise, and a joy that radiates to others. Where prayer is weak in our Meetings for Worship, the urgent call should ring out to cultivate this beautiful gift of the Divine in concert with the human spirit.

Our vocal ministry rises and falls with the quality of our meditation, worship and prayer. Such qualities in an individual's inward journeys enhance the depth of a gathered meeting — a corporate sense of the living God. However, do we encourage sharing of the spoken message, whether by a response in the same vein or by a later friendly expression? Do only a few turn to the Bible or other religious writings to prepare the mind and spirit for vocal ministry? Openness and a vibrant sense of expectation enhance both personal and corporate worship. Without hope or faith in the process of devotion, we are foolish to expect a religion of direct experience with the living God. Douglas Steere (1972) writes that the Meeting depends on a "faith that there is something going on in our silent waiting, something beyond our surface mind's capacity to grasp; that there is a yearning communication that is continually operative; and that an unprogrammed silent meeting for worship is a wonderful climate for communication to break through; and that when vocal ministry comes out of this ground of communication and articulates it for the needs of those gathered together, conditions for inward transformation and strengthening are optimum indeed."

The pattern of preparation by meditation, prayer and vocal ministry is intimately related to our nurture of spiritual leadership. After observing Friends over many years and several Yearly Meetings, Friends make an earnest effort for a meaningful religious education for our children, but in general terms we seem to let our Young Friends drift to find their respective ways. A few recognize the reality of the lack of sharing and the widespread dearth of leadership to work with these precious lives. By contrast, other denominations invest major resources of trained leadership, frequent programs, church camps and conferences, etc. for their youth. Friends, with the exception of the Earlham School of Religion, have not intentionally trained youth for the leadership of tomorrow. Should we, in the Illinois Yearly Meeting, have a more conscious plan to cultivate spiritual leadership among our younger members? Those of us with a gray or bald head will not be here forever; our future lies in a greater investment in our Young Friends, to work with them until they become the new leadership in our society. Again, the future is determined in large part by spiritual preparation — by what we do today.

My earlier emphases on patterns and preparations in the realm of science have some merit in the meditative life. While the Christian faith agrees in part, it differs in that the nurture of the religious life is not the sole route to understanding God. Faith also paves the way to God. Man must open himself — must bare his heart to be receptive to the invasion of God's presence. Long ago, David wrote:

> Whither shall I go from thy spirit?
> Or whither shall I flee from the presence?
> If I ascend up into heaven, thou are there;
> If I make my bed in hell, behold thou art there.
> If I take the wings of the morning,
> And dwell in the uttermost parts of the sea;
> Even there shall thy hand lead me, and
> Thy right hand shall hold me . . . (Psalm 139)

At the Edges of Experience

Biochemistry has been described as the chemistry of life ~~from bacteria and plants to animals and man; it covers the vast area in between biology and chemistry. Some of the fastest growing research areas today are between disciplines~~ genetics and biochemistry (witness the growth of our knowledge of hereditary diseases), physiology and electrical engineering (leading to artificial hearts), nutrition and biochemistry (development of high-lysine corn), molecular biology and biochemistry (leading to recombinant DNA) and many other examples. The most exciting biology is frequently at the interactions of different ecosystems: at the interface of rocks and lake, at the edge of ocean and the beach, between the shifting sands and the struggling grass, or at the timberline of tall mountains.

Is the religious life any different? We go all out to celebrate the birth of a new baby, the grand event of a 75th birthday or a 50th wedding anniversary, the warm caring and remembering of loved ones, and of course the joyous faces of everyone participating in a wedding. Expressions of truth, fear, discouragement, loneliness and other deep human emotions may prevail and have meaning in the growth of our soul. Each has a base in human reality and yet may move us to the edge of an encounter

with the Divine. Our human aspiration may be to approach, understand and transcend that edge, knowing that God can penetrate that edge. Phrased in poetry, Francis Thompson writes in *The Hound of Heaven*:

I fled Him, down the nights and down the days;
I fled Him, down the arches of the years;
I fled Him, down the labyrinthine ways
Of my own mind; and in the mist of tears
I hid from Him, and under running laughter …
And then near of the long pursuit,
'Ah, fondest, blindest, weakest,
I am He Whom thou seekest!
Thou dravest love from thee, who dravest Me.'

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