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‘Life’ According to the Bible, and the Scientific Evidence

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INTRODUCTION

In an earlier article[1] I focused on the original diet of the finished creation and a search of the biblical record was made with this question in mind. Did God leave His creation in a state where a scarcity of resources, natural selection, or eating of meat existed? The Scriptures suggest that there was sufficient food for all the birds, animals, and man. The Bible expressly states that God commanded the birds, animals, and man to eat only from the plant kingdom. Thus, the statements of Scripture are perfectly clear. Creation was not to eat meat of any kind, nor was resource scarcity a present reality.

The biblical text tells us the status of the finished creation. If it did not have any of these things operating when God finished His work, then the prospects of physical death before the fall of Adam are slight indeed. No active agent would have existed to cause death. When death occurs, whether seen from the vantage point of the Scriptures or from our experience, there must be some active external force to cause death.

Some would argue to the contrary that when any creature in the garden ate a plant it would have caused the death of that plant. Those who assert this also point out that modern biologists consider plants to be ‘living things’. They say this would pose a serious problem for those who insist that there was no physical death before sin entered the world. This is the typical argument:

> *‘However the absence of death would pose just as much a problem for three 24-hour days as it would for three billion years. Many species of life cannot survive for even three hours without food, and the ingestion of food requires at least the death of plants*’.[2]

It appears that a contradiction exists between what many believe, and what the Scriptures actually teach. This quotation implies that death has always existed on the earth, and therefore, God must be the one responsible for creating it.

All too often, people say they believe what the Bible teaches, but accept a popular idea without ever examining the Scriptures to see if such an idea is true. This idea of a ‘living thing’ could be exemplified by plants and animals. One definition of life is: ‘*taking in food, getting energy from it, growing, adapting themselves to their surroundings, and reproducing their kind.’*[3] This is how many differentiate between something that is living or non-living. Yet the Christian must ask: does this popular definition agree with the biblical definition of what a ‘living thing’ might be?

The Scriptures set forth limits or boundaries on every area of our thinking. Since the Bible is the authoritative Word of God, man must place his thoughts in subjection to the thoughts of God. So, regarding the definition of life, the Bible does set limits on what possesses life. This must be the determinative source for all areas of man’s study.

The discussion of these boundaries may appear as a ‘slough of despond’. Although it is necessary to examine the Scriptural boundaries in depth, one may lose sight of the forest because of the trees. To overcome this loss of focus, the reader must think of himself as a detective. The detective must examine all the clues that relate to the present issue. Once he has all the clues, then he can step back and see the whole picture. The reader needs to bear with the discussion and gather the clues as they surface. Once this task is complete, then it will be possible to step back and examine the whole picture of how the Bible draws the boundaries for defining a ‘living thing’.

A glimpse of these various boundaries may be illustrated from the books of Genesis and Leviticus. These are not the only places where the boundaries occur, but these two books clearly present them. In Genesis 2 God creates man and he becomes a ‘living soul’. In Genesis 7 two more limits occur; they are ‘flesh’, and ‘spirit’.

The final boundary comes from Leviticus 17:11. Here the text says, ‘*the life of all flesh is in the blood’*. This English translation is from two Hebrew phrases. The parts of these phrases will be examined in the Old and New Testament statements.

The interpreter must observe the use of each of these words as they relate to humans, animals, and plants. Space constraints will prevent a full semantic treatment of these terms, so a sampling of the evidence will be given here.[4–6] Upon finishing this task, it will be clear what the Bible determines to possess life. If it can be shown that plants are not ‘living’, in the biblical sense, then one can assert that there was no death, suffering, or scarcity in existence in the finished creation.

SOUL OR CONSCIOUSNESS

The Bible associates life and 'soul' together in Genesis 2:7. The 'soul', biblically speaking, provides an organism with the capacity to express desires and emotions. The entire biblical record must be studied to observe what possesses a 'soul'.

Old Testament View

In the Old Testament 'soul' is a translation of the Hebrew word *nepes*. This is the word that occurs in Genesis 2:7 describing what man became after God blew the breath of life into him. A major difficulty one encounters with this word is its broad semantic range. The lexicons, and dictionaries, have had this problem too when attempting to circumscribe the range of this Hebrew word.[7–10]

Another problem is this word's history. Some try to establish the history of *nepesh* by tracing it back to an Ugaritic or Akkadian word. Those who practice this method say the original meaning was 'throat' or 'neck'.[11–13] Yet conclusions of this type of extra-biblical historical approach should be considered less authoritative than a study of the biblical context.

Nepes more often refers to humans than it does to animals. The interpreter should expect this because the biblical text focuses primarily upon the relationship of man with God. Yet according to the Scriptures animals do possess consciousness. Not only do the Scriptures claim that animals have *nepes*, but they also attribute desires and emotions to animals. Animals possess desires for food (Proverbs 12:10), and water (Psalm 42:1, Joel 1:20). They also show the emotions of fear and despair (Lamentations 1:6), and love (Proverbs 5:19). These verses illustrate that animals have similar desires and emotions that humans possess. The most significant references to animals occur in Genesis 1:21 and 24. Here the Bible calls these animals 'living creatures', and consist of two different groups, the land and aquatic animals. The conclusion is that animals, as *nepes*, possess consciousness, which allows them to express desires.

Examining *nepes* in terms of humans, one finds a vast amount of material. The word encompasses the entire sphere of human life. So it can be used to show 'life' in its many facets. Johnson observes that the Old Testament uses it referring to conscious life:

> '. . . *The term* nephesh *may be used with more obvious reference to what are the comprehensive and unified manifestations of sentient life, as when it is said of the right kind of master that he understands the* nephesh *(i.e., the feelings) of his beast, or when the Israelites are reminded that in view of their experience in Egypt they are in a position to know the* nephesh *(i.e., the feelings) of a resident alien.*'[14]

Johnson argues that both humans and animals can be classified as *nepes* because they have conscious life and possess feelings (emotions) plus desires. Life according to the Bible must possess the capability of being self-conscious. If something does not possess self-consciousness, then it cannot be considered 'living'.

This word commonly occurs as a reference to the whole of life, not just to one specific aspect of it. Eichrodt says;

> *'Thus it becomes a substance which inheres the living even apart from the breath; it becomes equated with life. One can speak equally of the* nephesh *of animals and the* nephesh *of man.'*[15,16]

Thus, man and animals can show emotions and have relationships, because they share this very same quality. Robinson observes,

> 'nephesh *is not a spiritual entity which enters the body at birth and leaves it at death; it is simply a principle of life which makes the body effective and the body is the real basis of personality*.'[17]

Pedersen gives a good overview:

> *'By the breath of God it [the lump of clay] was transformed and became a* nephesh, *a soul. It is not said that man was supplied with a* nephesh. *Such as he is, man, in his total essence is a* nephesh.'[18]

Many who have written on the nature and use of *nephesh* share this same view, that it is necessary for something to be considered as living.[19–29] It is important to observe that the Old Testament view of life is holistic. Berkouwer summarizes the holistic idea of *nepes:*

> *'This does not of course imply that* nephesh *always refers to the totality of man, or that biblical usage is not deeply conscious of variation in man, of periphery and center, but it does mean that we may not see this variation and this centering as showing a localized religious part of man. On the contrary, the biblical anthropological references unmistakably appear to concern the whole man.*'[30]

So one can conclude that the Old Testament links *nepes* to man, and even to animals. It then refers to the whole being or any of its parts.

One further use that illustrates man in his entirety should be considered — the pronominal use. This can be observed when one would expect a relative term, such as 'he, she, his or her, etc.'. The Hebrew text uses *nepes* in its place. Brotzman makes this observation:

> 'nephesh *and a personal suffix (his or your) were used to parallel a simple pronoun. This requires that the exegete understands the words "his nephesh" as a circumlocution for "himself".*'[31]

This illustrates that the use of *nepes* may refer to the whole man, since it can replace a relative pronoun when speaking of a human being.

Although *nepes* refers to the whole man, the Old Testament has other words related to it. The first is the word for 'heart' (Hebrew: *leb).* Its function is essentially that of spiritual or mental activities.[32] Bowling likens it *'to the inner or immaterial nature in general or to one of the*

three personality functions of man; emotion, thought, or will.'[33–35] Pedersen notes the semantic overlap of *nepes* to *leb:*

> *'The relation between* nephesh, *soul, and* leb, *heart, is not that the heart is the designation of certain special functions. The heart is the totality of the soul as a character and operating power, particular stress being laid upon its capacity;* nephesh *is the soul in the sum of its totality, such as it appears; the heart is the soul in its inner value. One might just as well say "that which is in your soul" as "that which is in your heart." But whereas it can be said that Jacob came to Egypt with seventy souls, it cannot be said that he came there with seventy hearts.'*[36]

The point to be gleaned is this; in many respects these words often overlap in their referential significance, so both can refer to man in his entirety. Further, *leb* is only once used of animals to show emotion (2 Samuel 17:10 — this verse is comparing the heart of a warrior to that of the lion). One could rightly say that both animals and man possess this kind of emotion called *leb.* 'Heart' also can be observed in colloquial English, where the same trait is given to man and animals (that is, Richard the 'lionhearted').

The second term that has a semantic field overlap with nepes is the word for 'face*', panim.* This occurs in the Old Testament, pointing to the emotional aspect of man, carrying with it the significance of *'the identification of the person and reflects the attitude and sentiments of the person.'*[37] The use of 'face' in the Old Testament expresses these emotions or attitudes: fierceness, determination, defiance, happiness, sadness, fear, anguish, and anger. Johnson summarizes the relationship between *nepes* and *panim:*

> *'Thus the fact that the various expressions for the "fixing" or "turning" of the face in a particular direction normally serves as an obvious indication of purpose or intention, and thus point to the concentration of the* nephesh *(or the personality as a whole) upon the end in view, means that in many, if not most, of these cases the use of the Hebrew term* panim *does not fall far short of making it a parallel to the later term.'*[38]

There is only one reference in the Old Testament that uses *panim* to refer to animal emotion, 1 Chronicles 12:8. Here the author compares the fierceness of a warrior and that of a lion. So then, one can say that 'face' may appear in similar contexts as 'heart' or 'soul'. The face according to the Old Testament does represent the whole person as an emotional being.

The Old Testament gives examples of these states of animals by comparing the emotions of animals to humans. The Old Testament uses certain animals for such comparisons: donkey or mule, bear, lion, horse, gazelle, ant, bee, leopard, fox and the wolf. The emotional states that are compared are: cunning, fierceness, irritability, stubbornness.[39] So the Old Testament does illustrate the emotional or conscious part of animals by comparing their emotions to those of humans.

Therefore, one can speak of the holistic nature of man from the Old Testament, and of animals too, by the term *nepes* and semantic overlap with *leb* and *panim.* The Old Testament also presents evidence for the application of *nepes* to animal life, since they too have consciousness. The terms 'heart' and 'face', only used once concerning the emotional states of animals, are illustrative of the complex emotional makeup of man. The results gleaned from these words are that man and animals exist as emotional creatures made by God. Man and animals have emotional relationships, because they share the same essential makeup as *nepes.* Although that relationship has changed since the entrance of sin into the world, yet it is only man who can have an emotional relationship with God, because it is he alone that has the image of God.

New Testament View

The New Testament primarily uses the word *psuche* for *nepes* when quoting from the Old Testament (the Septuagint uses this word to translate the Hebrew words; *haya, ruah,* and *nepes).*[40] The majority of its appearances are in the Gospels and the Book of Acts.[41] This word has the same broad semantic range through Classical and Koine Greek that its Old Testament counterpart possesses.[42,43] It is interesting that many have tried to see a Greek philosophical meaning behind the New Testament use of *psuche,* but such attempts have not been successful.[44] It appears that there is some progress in the revelation of the immortality of the soul between the Old Testament and New Testament,[45,46] but it cannot be seen in the use of *psuche* alone. The idea of the whole man in the New Testament is emphasized by Ridderbos:

> 'Psuche *in Paul is neither, after the Greek-Hellenistic fashion, the immortal in man as distinct from the* soma, *nor does it denote the spiritual as distinct from the material.* Psuche *stands in general for the natural life of man.'*[47]

Guthrie shares the same thought:

> *'We should note the complete absence in Paul's epistles of any suggestion of the Hellenistic notion of the soul's pre-existence before the existence of the body. The one cannot exist without the other. Indeed Paul never links the two ideas in a description of a person, since either covers both, that is, the whole person.'*[48]

One can observe that the New Testament view of man is that man is a unified whole. The only reference to animals as *psuche* is Revelation 8:9, where it says that one-third of the living *(psuche)* creatures in the sea died. Thus, the New Testament considers both man and animals to be living creatures.

An important point to be gleaned from this is that nowhere in the Scriptures are plants ever given these characteristics. Man is distinct from all the animals, not

because he has a 'soul' but because he is in the image of God. Man can enjoy animal companionship because both man and animal are 'living'. Man and the plant kingdom cannot have an emotional relationship because plants do not possess this vital component of life. The relationship man can have with the plant kingdom, according to the Scriptures, is one of planter, harvester, and consumer. In terms of this one defining boundary, plants are not living and therefore cannot be subject to physical death.

FLESH OR MUSCLE

The second characteristic of life, as the Bible defines it, is the possession of 'flesh'. This is both a physical characteristic and an emotional one. This section will examine what the Scriptures signify by this aspect and how it relates to the definition of 'life'.

Old Testament View

The Hebrew word for flesh is *basar*. This word occurs throughout the Old Testament, and, like *nepes*, has a broad semantic range.[49–53] The basic idea is some form of corporeal nature.

Basar, when used of animals, refers to the flesh of the animal (that is, the muscle tissue and skin). One can observe this in Genesis 9:3 when God first gives man His permission to eat animal flesh. The Mosaic law also imposed restrictions on the eating of the *basar* of animals (Leviticus 17:13, Deuteronomy 12:16,24). Yet most of the occurrences of *basar* in the Old Testament discuss the use of animal flesh in the sacrificial system. Within the Old Testament one finds that the term 'flesh' refers to the flesh, or the muscle and skin of the animal.

The use of 'flesh' describing humans occurs 169 times out of 273, the remainder referring to animals.[54] Wolff describes the significance: '*This alone shows that basar is the term for something that is broadly characteristic of both man and beast.*'[55] The major physical characteristic that both man and animals share, is that both man and animals have flesh, or muscle. This word, when referring to humans, can signify the entire physical body, or just parts of it (Numbers 8:7 and Job 4:15 appear to refer to just the head and not the entire body).

The idea of a relationship between beings, whether it is man and man or man and animals, also can be shown by the use of 'flesh'. The relationship among brothers or nations can be expressed by referring to a common flesh (Genesis 37:27, Nehemiah 5:5). It can be used as a reference to all living things, as in Genesis 6:12 and 17 (cf. Genesis 9:16). All things with *basar* are grouped together probably because they all can share in the blessings of God's provision.

Another meaning of 'flesh' as it applies to humans, has the idea of weakness. Often in the Old Testament, to rely on one's own strength is to rely on his *basar*. This functions in a contrastive sense with one trusting in God's faithfulness (Jeremiah 17:5,7). One also might note that this weakness could have a physical connotation comparing human might with God's (2 Chronicles 32:8). Wolff observes; 'basar *not only means the powerlessness of the mortal creature but also the feebleness of his faithfulness and obedience to the will of God.*'[56] Thus 'flesh' in the Old Testament can signify either a physical or moral weakness, or the physical body.

The Old Testament refers to the physical substance of both man and animal with *basar*. Therefore, *basar* is never used to describe God. When the Old Testament calls humans 'flesh' the term has a broader semantic sense, for it can signify the idea of moral weakness. When animals are referred to as 'flesh' it focuses on something used either for food or for sacrificial purposes. Yet both *nepes* and *basar* are semantically related as Pedersen notes:

> *'When in the story of the creation it is told that God breathed the spirit of life into the man of clay he had molded, it must not be construed in the manner that the clay is the body, the spirit of God the soul, which is seated and acts within the body. The man of clay was a dead thing, but by the breath of God he was entirely changed and became a living soul. Soul and body are so intimately united that a distinction cannot be made between them. They are more than "united": the body is the soul in its outward form.*'[57]

The *nepes* signifies the animating principle of both man and animals, and it is the 'flesh' that is animated. If the *nepes* were to depart, the *basar* would die, yet one cannot be a *nepes* (other than God himself) without possessing a *basar*.

New Testament View

The New Testament continues and broadens the thought pattern seen in the Old Testament. It illustrates a continuity with the Old Testament in that the 'flesh' refers to both the outer physical part of man and his moral weakness. Yet in the word *sarx* a different side for 'flesh' surfaces. This term *sarx* translates the Hebrew word *basar*.[58]

One should note the semantic range in this word. The Classical Greek illustrates six uses of *sarx,*[59] whereas the New Testament shows eight distinct uses of this word.[60] Paul provides the most interesting usage of *sarx.*

Most of the occurrences in the Gospels and Acts refer either to the physical body, or to some aspect of it similar to Old Testament usage. This can be illustrated by the comparison that our Lord draws between flesh and blood or between flesh and bone (Matthew 16:17 and Luke 24:39). The second chapter of Acts uses *sarx* concerning the body of Christ, and all humanity. *Sarx* may also signify the marriage union (Matthew 19:5–6 and Mark 10:8). The Old Testament idea of a physical body or a relationship among creatures is reflected in the New Testament use of *sarx.*

The most significant development from the Old Testament occurs in the Pauline literature. Paul refers to the 'flesh' as an instrument of sin (Romans 7:18, 13:14, Galatians 5:16–19). This is similar to the Old Testament idea of weakness that exists in the flesh as unbelief, but Paul goes further, in that he establishes the root of the weakness. The weakness in the *sarx* is a sin principle that governs the individual.[61] Schweizer supports this idea: 'sarx *approximates to the idea of a power which works on man and determines his destiny even beyond life on earth.*'[62–65] Still, one cannot separate between the principle known as *sarx* and the actual physical body of *sarx.* Man, in the unbelieving state, is who he is because he is 'flesh'. The 'flesh' principle is very strong and refers to the complete man.[66] This use of *sarx,* as a principle, could be illustrated by the occurrence of the adjective 'fleshly'. This signifies the actions of believers who are not living up to their 'spiritual' calling in Christ. Paul, by using *sarx* in this manner, links the physical body and the 'soul' into one unit. So although Paul adds to the semantic range of *sarx,* he is not in essence altering its meaning.

Finally, one other term should be alluded to at this point, the word 'body' (Greek *soma).* This is a rare word in the Septuagint and translates *se er,* which refers to a specific part of the 'flesh', and *nebela,* the word for 'corpse', and occasionally, for *basar. Soma* refers to the physical body and occurs with other terms such as 'blood' and 'bone'.[67] When it appears in the New Testament *soma* refers to something that will be completely transformed in the future resurrection. Whereas *sarx* is being transformed while living on earth, so it will not be affected by the bodily resurrection.[68–70] When *soma* appears it is descriptive of the physical body, in contrast with *sarx* which sees man holistically.

The New Testament uses both *sarx* and *soma* referring to animals. The book of Hebrews discusses the fact that the bodies of animals were burned outside the camp (Hebrews 13:11), referring to the carcass of the sacrificial animal. John uses *sarx* of the flesh of horses after the great battle (Revelation 19:18). Although there is little mention of animals in the New Testament, it appears that animals do possess the same physical flesh as humans.

Clearly nowhere in the biblical record is one told that plants possess any kind of 'flesh'. The New Testament declares that humans and animals possess *soma* and *sarx.* This follows the Old Testament use of *basar* as it relates that to plants. The only possible conclusion which can be drawn is that the Bible does not afford to plants the status of 'living things'. On the second boundary of life, one can find no mention of plants in the Bible.

SPIRIT OR BREATH

The third necessary aspect is that of 'spirit' or ' breath'. This term (and its usage) is broad, yet like the other two it functions with 'life', so that which does not possess this aspect is not living.

Old Testament View

The Hebrew word that is most applicable is *ruah.* The semantic range of this word is very broad.[71–73] As it occurs in the Old Testament, both man and animal possess a *ruah.* The use of this word is very unusual as Wolff observes:

> *'A mere glance at the statistics shows that ruach can be distinguished from* nepes *and* basar *in two ways. In the first place,* ruach *is to a large extent the term for a natural power, the wind, this meaning being applicable in no less than 113 out of 378 instances. In the second place,* ruach *more often refers to God (136 times) than to men, animals, or false gods (129 times), that is to say in about 35% of all instances. I may note that it is typical that* ruach *never appears in the book of Leviticus, whereas we come across basar in Leviticus more than any other book of the Bible.*'[74]

This is an interesting observation that Wolff makes concerning the occurrences of *ruah* — seldom does it refer to man or animals. The references of *ruah* to animals are few, in fact there are at most twelve clear references to animals having a *ruah* and four of these are associated with humans. Payne states that the animals gain their *ruah* from the earth (Genesis 1:24) while man's comes by the creative breath of God (Genesis 2:7).[75,76] In the Flood God destroyed all that had the 'breath of life', which included both animals and humans. When *ruah* refers to animals, it points to either animals breathing, or to the immaterial principle of life that makes them *nephesh.*

Man is the subject of *ruah* approximately 100 times in the Old Testament; illustrating man's emotional state plus his physical state. When this word represents the physical nature of man *ruah* refers to the physical breathing that sustains his life (Genesis 6:17, 7:15, 22, Psalm 104:29, Habakkuk 2:10). It is interesting that whereas *nepes* examines the whole man, *ruah* allows such a separation. Man's *ruah* is from God and, at death, returns to God.[77] The existence of man is very much dependent upon the grace of God.

Since man has a 'spirit', given by God, this word can also signify that he is a whole person; this total personality of man can be assigned to the function of his *'ruach'.* Eichrodt observes this function:

> *'From the habit of describing the movements within the psyche as manifestations of the* ruach *present in man there arose in later times, as men acquired a better understanding of the autonomy and unity of the psychic life, a development by means of a simple generalization whereby the* ruach *was made responsible for all psychic affects, and was indeed virtually regarded as the organ of psychic life.*'[78]

Thus, one can say that all man's emotions are generated from the *ruah.* Many passages allude to this type of activity, and the book of Proverbs contains many examples.

As one examines the boundaries the Bible places on

'life', it should be noted that the *nepes* applies to the whole being, *basar* applies primarily to the physical nature of the being, and *ruah* primarily to the non-physical nature of makeup. Whitlock notes this in the following quote:

> *'In Hebrew psychology, the weakness of the flesh (creature) is set off in contrast to the power of God. In this context, the person is shorn of any undue confidence in self. The Hebrew would assume that selfhood could not be achieved through will power. The courage to realize the potentialities of being a whole person comes from God. Indeed, it is the* ruach *of God who enables the person to act in any way whatsoever.'*[79]

Because God created man's 'spirit', and God is himself 'spirit', they can have a relationship of total personalities. Man shares much with animals, but he can never have the same kind of relationship with them that he has with God. Animals possess a *ruach,* but it is a by-product of their creation from the ground not given to them in the same manner as the human *ruach.*

The one parallel word to be examined is *nesama.* It occurs 23 times in the Old Testament. When it refers to God, it speaks of the breath or wind that energizes or judges men. When its subject is man and animals, it speaks of the process of respiration and links it with their physical life. This can be observed from the Flood narrative, where *nesama* is linked with life. The loss of *nesama* is death. Some have tried to put more into this term than warranted by the context.[80] This word is synonymous, in certain contexts, with *ruah* (c.f. Genesis 6–9).

Ruah can refer to the breathing activity of men and animals. When used exclusively of men, it can refer to the holistic function of man as Robinson states:

> *'So far as the term* ruach *is used of man, it denoted life-energy in general which could be quickened by some new accession of* ruach *energy from God. When* 'ruach'*, from the exile onwards, had become naturalized in human nature as a synonym of* nephesh *or* leb*, it still suggested this reference to the continued use of* 'ruach' *for some supernatural influence, and so supplied a point of contact between man and God. The importance of this becomes apparent in the New Testament, where Pauline anthropology partly turns on the identity of the permanent* pneuma *in man with the Christ-pneuma, the indwelling Spirit of God underlying the new creation.'*[81]

The significance of Robinson's statement is that it illustrates the interrelatedness of the *nepes* and *ruah.* The intended description is of an immaterial aspect that is resident within man. This word does not seem to refer to the immaterial nature of animals. Yet because of the semantic overlap between *nepes* and *ruah,* one should not be dogmatic regarding the immaterial aspect of animals. Indeed, one could get a glimpse of the immaterial aspect of animals from Ecclesiastes 3:21. Whatever one may conclude about the *ruah* of man and animals, it cannot be separated from the person or animal. It is a vital part of what the Old Testament considers 'living'. One also should note that these terms, *ruah* or *nesama* are never used of plants.

New Testament View

Having considered the Old Testament use of *ruah* it is necessary to examine the New Testament use of a similar word *pneuma.* This word normally translates the Hebrew word *ruah,* and the other related term *nesama*.[82] In the Gospels and Acts the use of *pneuma* is the same as the Old Testament. One can see this term used of God, of demons, and of man in his emotional and relational aspects. Unlike the Old Testament, the New Testament never ascribes this aspect to animals, though it does refer to breathing in humans.

When one encounters Paul's writings, one observes an amplification of the Old Testament usage. Paul uses the term *pneuma* to suggest a mode of existence as opposed to the flesh. One can see this clearly in Galatians and Romans.[83] Paul paints the picture of living in and by the Spirit as opposed to the flesh. He stipulates that the spirit must be made alive in the individual or else he is dead in sin. Schweizer makes this point:

> *'The data may seem confusing, but they become quite clear when one realizes that Paul thinks wholly in terms of the work of the Spirit of God and perceives that the whole existence of the believer is determined thereby. For Paul, the Spirit of God is not an odd power which works magically; the Spirit reveals to the believer God's saving work in Christ and makes possible his understanding and responsible acceptance thereof.'*[84]

Paul links the life of the believer to the work of the Holy Spirit on the inner man, yet one also should allow the believer to possess a human or natural *pneuma* as well. Guthrie places both the human *pneuma* and God's *pneuma,* in the life of a believer, in a proper perspective:

> *'For the believer,* pneuma *seems to mean the whole man in fellowship with God. Non-Christians cannot have fellowship with God, for the natural man cannot discern the things of God (1 Corinthians 2:6ff) ... It is difficult to conceive of* pneuma *as something added to man's existing state. It is more reasonable to consider that man's natural spirit, which in his unregenerate state is inactive, is revived a t conversion by the Spirit of God. If this is so, a distinction must be made between man's natural* pneuma *and his Christian* pneuma*, although the connection between them is close.'*[85]

One should observe that man can be referred to holistically in terms of *pneuma.* The natural man's *pneuma* does not respond to God, and therefore must be regenerated by the Holy Spirit to have fellowship with God. It is up to the believer whether he will have fellowship with God through

the Spirit, or whether he will live according to the dictates of his *sarx*. Paul thinks of man as a whole that cannot be divided into two distinct parts and still have a living human.

It must be noted that one can speak of a *ruah* or *pneuma* of humans and of animals, but these terms never describe plants. Whether one takes these terms to refer to the physical act of breathing or to some immaterial aspect within the being, one cannot separate these characteristics and still have a 'living thing'. Plants fail to meet this third requirement for possessing biblical life. All life must possess a *ruah* and *pneuma* as animals and humans do, but plants do not possess this aspect of life.

BLOOD

The fourth biblical criterion for life is very important. The Bible's doctrine of salvation has at its foundation that blood can atone for man's sin. There is no disagreement about the meaning of this term; it is the same thing that flows through human and animal bodies.

Old Testament View

As one studies the use of 'blood' in the Old Testament, one cannot escape the related idea of atonement. As stated above, there is no doubt that what God intended by the Hebrew word *dam* (translated 'blood') is that which gives life to the body. There are two basic views regarding the significance of blood in the Old Testament. The first is that blood is a symbol of death. Hamilton says that 'blood' denotes death *'or more accurately, life that is offered up in death.'*[86] This idea appears frequently by the use of the plural of 'blood' (*damim*), which speaks of a violent death. The word *dam* can refer to death, but only in a figurative sense, in that it is a picture of the depletion of a vital part of life resulting in death.

The other interpretation is that it functions closely with *nepes*, illustrating that the significance of this term may be found in life, not death. The occurrences of *dam* are mostly in Leviticus and Ezekiel. These are books that discuss the role of the sacrifice. The best statement can be found in Leviticus 17:11 which reads:

> *'For the life of the flesh is in the blood, and I have given it to you on the altar to make atonement for your souls; for it is the blood by reason of the life that makes atonement.'*

The idea that the blood represents the life of the individual is illustrated by the last phrase, and there are two interpretations. First is that the 'by reason of the life' *bannepes* refers to the instrumental use of the Hebrew preposition b.[87] Gesenius defines this as *'that which represents the means or instrument, as something with which one has associated himself to perform an action.'*[88] The argument is that the blood and life stand in a causal relationship, so that the life and blood produce the atonement, rather than the substitute for the offerer. The second interpretation observes that the last phrase of this verse is using the preposition 'of price'. Its use gives the idea of a price of a substitute.[89–91] Baruch Levine states:

> *'This preposition does not indicate the means in a causational sense, but rather designates that which amounts to the equivalent of the other, and which can, therefore substitute for it if required . . . The act of sacrifice represents a process of several stages. The substitution of a victim and the transfer to it of the impurity and sins of the worshippers.'*[92]

This, the idea of an expiatory sacrifice, is truly the center of the Old Testament sacrificial system and the main focus of Leviticus 17:11.[93] Wenham says, *'in other words the life of an animal is represented by its blood being splashed over the altar.'*[94–98] The idea of substitution is clear between worshipper and victim.

The Old Testament closely links all three of the parameters of life covered up to this point. Leviticus 17:11 shows that blood refers to the life of the individual given in exchange for the life of an animal. This illustrates, according to the Old Testament, a 'living thing' must possess consciousness, flesh, and blood. If these things are not possessed, then the thing is not 'living'.

New Testament View

The New Testament illustrates the same points just addressed. First, one can see a close link between the Old Testament and the New Testament (especially in the Book of Hebrews) that the blood is necessary for 'life'. Yet in all the 456 occurrences, not one speaks of plants as having blood. So then, plants cannot be considered as 'living' things in the biblical sense. Second, the blood represents the life of one who replaces another. In the Old Testament animals would replace humans. But it was the Lamb of God, our Lord Jesus, who took our places in receiving God's wrath. So then to misunderstand the role and significance of blood, is ultimately to cast a long shadow on the death of Christ.

LIFE

The last biblical parameter for the defining of 'life' to be considered is that of 'life' itself. Although this is a general kind of term, its association with the previously discussed parameters of 'life' would confirm the above assertions.

Old Testament View

When one examines the word for 'life' or 'living' in the Old Testament, one notices the complexity of its use. Even the lexicons are aware of this great complexity. The basic idea of this word is difficult to describe, yet Elmer Smick gives a good description:

> *'The Old Testament speaks of life as the experience of life rather than as an abstract principle of vitality which may be distinguished from the body. This is*

> *because the Old Testament view of the nature of man is holistic; that is, his function as body, mind, spirit is a unified whole spoken of in very concrete terms. Life is the ability to exercise all one's power to the fullest; death is the opposite*.'[99]

The point, which Smick makes, is that 'life' according to the Old Testament is to be thought of as holistic. Johnson says the same thing:

> *'For the most part, however the idea of life is expressed by means of the masculine plural* hayim, *which by its very form conveys a suggestion of the intensity or expansiveness not to be divorced from the many and varied concrete expressions of "life".*'[100]

Considering the above statements, one would then expect to observe this Hebrew word for 'life', *haya,* in a variety of contexts.

One can see four contextual meanings for *haya.* The first is to be seen as signifying the life span of the individual. The clearest illustration is in the genealogies of Genesis 5 and 11.[101,102] The second usage is as a contrast with the Hebrew word 'death', *(mut).* When 'life' is contrasted with 'death', existence or survival in the land of the living is the topic of discussion.[103,104] The third usage, is that of holistic life. This seems the most prevalent usage in the Old Testament. It refers to the individual's standing with Yahweh. This can be illustrated in the Psalms, with the meditation on the law. Here one also encounters the Hebrew word for 'good', in its semantic significance of moral uprightness or one being in a beneficial place in the covenant. The Old Testament looks upon the whole life of man including his religious actions. How man acts in relation to God will have an effect on every area of his life. Two other words also should be mentioned; the words 'peace', and 'blessing'. These words show the results of living in a proper relation to the covenantal regulations, but the opposite could be true if one is not living according to the covenantal regulations. The final idea conveyed by the Old Testament, although it might be placed under the third, is God as the giver and sustainer of life. The Hebrew phrase 'living soul', is the phrase used to show 'life'. The word *haya* appears with God's activity in resurrecting the dead.[105] So God is the One who ultimately controls life in all its expressions.

New Testament View

The New Testament and Septuagint use two terms for the Hebrew *haya* — they are *bios* and *zoe.* The Septuagint uses *bios* to show the lifespan of an individual,[106] and *zoe* shows the various aspects of life.[107] The New Testament uses the word *bios* 11 times and it signifies physical life or sustenance (1 John 3:17).[108] It is noteworthy to see the great semantic crossover between these two words as they appear in Classical usage.[109,110] One should further observe that in Classical Greek the word *zoe* is extended to plants and understood as a vitality.[111] Bultmann discusses the New Testament use:

> *'In the New Testament* zoe *is first used of the natural life of man. Its opposite and end are found in natural death .... It expresses the absolute dependence of man on God and the transcendence of God's existence*.'[112]

Bultmann suggests that there might be some progress in the idea of 'life' in the New Testament:

> *'Death is no more understood as a natural phenomenon than* zoe. *It is neither self-evident nor necessary. It is a punishment for sin. This means, however, that in the New Testament thinking indestructibility is part of this concept of life. In this sense* zoe *belongs to God and this* zoe *is true* zoe. *Similar to this is the fact that men who are bound to natural life can be called dead in spite of their natural vitality*,'[113]

As indicated, under *haya,* life in all its expressions is based on one's standing within the covenant, so the New Testament takes this idea and broadens it. Now the individual believer, not the whole nation, stands before God and His regulations. According to the New Testament an individual may be judged for not keeping God's regulations (1 Corinthians 11:30, 1 John 5:16–17, James 5:19–20). Most of the New Testament theologies lend themselves to some form of dichotomy, in the definition of 'life', in that they state that the 'true' realm of life is in some future state.[114–119] Yet it would be better, in the light of the entire tenor of Scripture, to understand the true life as a present reality and also a future promise.[120] So one should understand that the New Testament usage of *bios* and *zoe* is similar to the Old Testament usage of life in a holistic sense.

One should observe that never do the Scriptures attribute the aspect of 'life' to plants. The words that are used to discuss life are only used of humans, and animals. Animals are given the terms *haya* and *zoe,* men are given these terms in a further developed sense because they are created in the image and likeness of God. Plants are nowhere given the same status as animals and men.

However, it is interesting to observe that in Classical Greek thought plants were given the status of 'living'.[121] Could it be possible that much of the modern biological thought has been heavily influenced by Greek pantheistic thought? If this is true, it is all the more reason for those who believe the Bible to bring 'every thought into captivity' to the authority of the Scriptures.

SCIENTIFIC EVIDENCE ON 'LIFE'

So far we have dealt with the biblical evidence on the definition of life. Now we need to deal with the scientific evidence that supports our conclusions as to what constitutes biblical 'life'. However, someone may say 'this guy is not a scientist, so how can I trust his scientific evidence?' It is true that I do not have training in the

sciences. Yet my purpose with this evidence is to suggest that what the Bible teaches can be supported by science. I have done my research carefully, and have sought input from biologists. I believe what follows is a fair representation of the scientific literature.

We will attempt to take the biblical boundaries already discussed and apply them to the biota of today. I have already suggested that plants are not 'living' things. This, of course, is a heretical statement as viewed by modern biology. Still, the question that must be answered is: Can we find evidence to support the biblical teaching? With what follows, I seek to ask the Christian biologist to rethink the modern idea of 'life'.

Flesh

The first boundary that we must consider is flesh. Recall that the discussion of flesh focused on the word *basar*. We should examine the extent of this word as it refers to man and animals. This word may refer to the whole of the individual or animal. It also appears that this word may signify only a specific portion of the flesh. When *basar* refers to animals, it can signify that which man eats (Genesis 41:2–3, Exodus 12:8, 16:12). These are only a small portion of the verses that discuss this subject. As one examines the whole theme, it appears the portion consumed is only the skin and muscle tissue. The use of *basar* referring to humans is similar in that it focuses on the skin and muscle (Genesis 17:13–14, 40:19, Leviticus 13:1–59). The description apparently refers to the organized striated muscle tissue covered by a layer of skin. Both animals and man have two kinds of muscle tissue.[122] One is the striated muscle group, this is a rough textured muscle. Second is the smooth muscle, this is the makeup of many organs. The Old Testament has words referring to the internal organs and fat tissue. *Meim* is the general word for the entire system of internal organs, or just the reproductive organs. *Meim* also may have a figurative meaning.[123] The Hebrew language has a word that can specify the kidney — it is *kilya*.[124] *Kilya* occurs in the Old Testament primarily in the sacrificial system. The priest removed the kidneys and burned them as a special offering to God. If the Old Testament desired to include the internal organs as part of the description of man or animals, it possessed the terminology to do so. Hebrew also had three words for fat: *bari*[125] *dashen*,[126,127] and *halb*.[128] All three of these words occur within the sacrificial system. So, the restrictive use of *basar* is significant. It refers to a special organized muscle system and its usage in this manner eliminates the other possibilities of smooth muscle (organs) and fat.

It appears that contractile capability or motility are present in many types of organisms in our modern world:

> *'Highly organized fibrillar or tubular elements occur in the cytoplasm of cells with well developed contractile capability. The various kinds of muscle systems are only one category of specialized contractile systems. Others, more widespread, include the spindle, a temporary organelle that appears in the cytoplasm of a dividing cell. Other systems are the cilia and flagella. They occur on many plant and animal cells.'*[129]

But contractile ability is not the issue. The issue focuses on the organized contractile mechanism of muscle tissue. It appears that the first occurrence of this type of tissue structure is in the Coelenterate phylum.

Gardiner makes the following observation about the appearance of muscle tissue:

> *'In these (the Cnidaria, a subphylum of Coelenterate), the cell body has sunk below the surface and lies alongside the fibrillar region. Although connection with the surface may still be retained by a slender protoplasmic thread. Distinct muscle fibers, with no connection to an epithelial cell, are, however found in other Anthozoa and Scyphozoa. They either lie singly in the mesoglea or are collected into conspicuous muscle bands.'*[130,131]

So one may trace the use of muscle tissue through the various groups of invertebrates such as insects, spiders, molluscs, to the vertebrates. Yet there is more to the striated muscle system than just the muscles themselves.

Most of the striated muscles have some place to attach themselves — the skeleton. Beklemishev states the importance of the skeleton to animals:

> *'In contractile elements, that apparatus always contains non-contractile formations that fulfill passive mechanical functions, especially the functions of uniting the contractile elements and of resilient opposition. These play the role of antagonists to the musculature contractions. In addition, any energetic contraction of the musculature requires increased solidity at the points where the increased force is applied. Therefore the contractile-motor apparatus includes skeletal elements in the wide sense of the term.'*[132]

Robert Carroll says something very similar. *'Most vertebrate activities are associated directly with the skeletal and muscle systems whose fundamental units show extremely limited variability.'*[133] This also could be stated in the following:

> *'Striated, or striped, muscle constitutes a large fraction of the total body weight. The movement of the limbs depends on the contraction of striated muscles, and posture is maintained by them. Both ends of most striated muscles are attached to the skeleton and thus known as skeletal muscles.'*[134]

Gardiner states precisely the definition of striated or skeletal muscle tissue:

> *'By definition, the skeleton of an organism consists of the more rigid tissues that provide protection or support for softer and more delicate parts. This definition may be properly expanded to include, as another and perhaps the primary function of a skeleton.*

This provides a means by which the contractile elements may be antagonized and extended after a contraction.'[135]

As it turns out there are two kinds of skeletons that animals may have. The first is the 'hydrostatic skeleton'. This is the kind of skeleton that most of the invertebrates use. This kind of skeleton *'requires an enclosed and incompressible volume of fluid against which the muscles can work, and this is provided by the body cavity.'*[136] In many invertebrates there is a structured connective tissue that serves the mechanics of muscle attachment.[137] The second kind of skeleton is the 'stiff skeleton'. This has *'regions of hardened material incorporated into the body, with muscles arranged usually in antagonistic pairs to pull against them.'*[138] So whether one examines vertebrates or invertebrates the answer is still the same. There must exist some form of skeletal system so the muscles can fulfill their task. There is also another component to this design, namely the nervous system. It appears that the muscles and the nervous system function together from the invertebrates on up the classification system.[139] So the muscles must function within a specific area, and this area must be the skeletal system.

Now let us consider the make up of the muscles themselves. The muscle cells have a fibrous material — actin and myosin, the myofilaments — organized into myofibrils.[140] Actin, myosin, etc., are also found in the contractile processes of non-muscle cells, but non-muscle actin differs in some molecular features from muscle actin and is coded by a different gene.[141] So the muscle structures of those animals who possess them are very complex, yet one should ask if plants possess these same characteristics.

It must be admitted that plants do possess similar characteristics found in animals in terms of the basic structure of muscles. Plants do have microtubules and microfilaments that are similar to animal forms.[142] Plants also have the proteins actin and myosin, although myosin is not in as high a concentration as it is in animals tissues.[143] The non-muscle microfilaments participate in the contractive process, but through a different mechanism. This contractility includes: cytoplasmic streaming (the flow of cytoplasm around the inside of plant cells), and ameboid movements (movements of single protist, fungal, and animal cells in which protoplasm flows out from the cell. This forms a false foot, resulting in movement of the cell along a surface).[144] Then there are types of movements in plants that are not predicated on contractile processes. The first is that of the stomates. Some might think that this movement is homologous to muscle contraction, yet it is entirely dependent on water pressure, not contraction as Salisbury states:

'Stomates open because the guard cells take up water and swell. At first, this is puzzling. One might imagine that the swelling guard cells would force the inside walls of the stomate together. Stomates function the way they do because of special features in the submicroscopic anatomy of their cell walls. . . . The result of this arrangement of microfibrils, called radial micellation, is that when a guard cell expands by taking up water, it cannot increase much in diameter, because microfibrils do not stretch much in their length. But the guard cell can increase in length. Therefore, because two guard cells are attached to each other at both ends, they bend outward when they swell, which opens the stomate.'[145]

Yet this is just the opposite of how the hydrostatic skeleton works. The muscles work by opposing each other against the skeleton. Here in the stomates, the water does all the action, and the microfibrils just receive the benefit.

The second specific movement is the ascent of sap up the trunk of a tree, or for that matter any vascular plant. Again Salisbury points out that microfibrils are not related to muscles:

'Cohesion is the key. The mutual force of attraction between the water molecules in the pathway. In that special environment, these cohesive forces are so great that water is pulled, by osmosis and evaporation, from its holding points in the cell walls at the top of a tall tree. The pull extends all the way down through the trunk and the roots into the soil.'[146]

So one can observe that even the ascent of sap up a vascular system is not the product of some contractile mechanism, but the result of water pressure extended down the vascular system. So can one say plants possess muscular activity? The plain and simple answer to that question is no. Plants do not possess muscular activity, and so do not pass the first biblical parameter of life, the possession and activity of muscles.

At this point it might be wise to digress and discuss the idea of evolution of the muscle system in animals from plants. There are many problems with this theory, and in the light of the above section, let us examine the issue of muscle evolution. This supposedly started with the plant kingdom. One view of the evolution is the 'Telome theory'. This theory deals with comparative morphology of a primitive branching plant, which ultimately became vascular plants.[147] Yet many doubt this, and point out that it is of small value.[148] They never tell us how muscles could have developed from plants, nor have they ever suggested any transitional forms. It would appear that the basis for the evolutionary model of muscle development is entirely upon morphological homology. It is fair to say that plants do not have anything similar to muscle tissue *per se.* As one investigates the advancement of muscle diversification specifically in vertebrates this is the main line of argumentation. Milton Hildebrand gives a perfect example of this argument:

'To trace the evolution of individual muscles one must have criteria for recognizing homologous muscles in different taxa. Within orders it is usually possible, and within families it is nearly always possible, to recognize

equivalent muscles based on position and relationships with other muscles and with the skeleton. Thus, the supraspinatus muscle of mammals always occupies the supraspinatus fossa of the scapula.'[149,150]

If one were to consider the evidence seriously, one must conclude that this argument really does not prove evolution at all. What it proves is common need calls for common structures. Morphological homology is not a proof for or against evolution, yet it is the major proof for this belief system. Even a recent book on genetics argues from this perspective when discussing macroevolution.[151] One further observation, when authors argue for evolution, they usually discuss the various aspects of speciation and microevolution. These authors do not attempt at spanning the gulf between plants and animals, and animals and humans. It would appear that the basis of their argument is circumstantial evidence, and one's presupposition or belief system controls that conclusion. So the same evidence could be used to support Divine creation or evolution.

Blood

The next area of comparison between plants and animals is that of blood. As already stated, the meaning of this term is clear. This term means that which flows through the animal's body. There are no related terms to *'dam'*, it is in a class all by itself. Here we will examine four areas of blood. The first question to be explored is; what is the definition of blood?

Blood is of course a liquid, yet it is much more.

'It is largely water, providing anon-viscous transport medium with good solvent properties. It also contains mineral ions, foodstuffs, metabolites, hormones, and proteins with transport functions.'[152]

Blood is then a means of transport throughout the body of humans and animals. Lehninger and Ratnoff echo this idea of blood. Lehninger points out in his book on biochemistry that:

'The blood is the vehicle for metabolic communication between the organs of the body. It transports nutrients from the small intestine to the liver and other organs and transports waste products to the kidneys for excretion. The blood is also the vehicle for transport of oxygen from the lungs to the tissues. It also functions to transport carbon dioxide generated during the respiratory metabolism of the tissues to the lungs for excretion.'[153]

In his article on blood, Ratnoff says:

'Blood is the vehicle of transport that makes possible the specialization of structure and function that is characteristic of all but the lowest organisms. It is a suspension of various types of cells in a complex aqueous medium, the plasma. The elements of blood serve multiple functions essential for metabolism and the defense of the body against injury.'[154]

Conley specifically addresses human blood in saying:

'Human blood has specialized cells of several types suspended in a liquid medium, the plasma. It is well adapted for its role in the transport of many substances to and from the organs and tissues. The circulatory system provides the mechanism by which it achieves this vital function. The circulating blood continuously supplies oxygen, nutrient substances, and other materials necessary for the viability and activity of the body's cells. If blood flow ceases, death occurs within minutes because of the harmful effects of an unfavorable environment on highly susceptible cells.'[155]

This statement sounds similar to the Leviticus 17:11 passage where God says the life of the flesh is in the blood. God knew what He was saying to the Hebrews, for the blood represents life. Many animals possess blood, as Gardiner states:

'But for metazoans of any size and complexity of organization there must be some transport system to convey materials around the body from the sites of their entrance or production to the sites of their utilization or elimination.'[156]

So then, one may glean from these statements a definition of blood. It is that system of transport in liquid form flowing through the body. The idea under all the definitions is the transport system. We will examine exactly how this transport system functions, but first one must understand of what materials this transport system consists.

As previously suggested, blood contains various items. Put very simply:

'Blood is very complex in its chemical composition since it carries many nutrients, metabolites, waste products, and inorganic ions. This makes possible the coordinated interplay and integration of metabolism in the various organs of the higher animal.'[157]

One may find in human blood several major substances with other components making up the substance. The major substances in human blood are: plasma, red cells, white cells, and platelets. Conley's discussion is thorough and will be summarized here. First to be considered is plasma. Plasma is *'the liquid portion of the blood, it is a solution of enormous complexity containing more than 90 percent water.*'[158] The water of the plasma is very interesting because it *'is freely exchangeable with that of the body cells and extracellular fluids and is available to maintain the hydration of all tissues.*'[159] Also contained in the plasma are proteins, with the major protein being albumin, followed by the globulins, fibrinogen, and lipoproteins.[160] The other parts of plasma are fats, called lipids, and sugar, called glucose.[161]

The second component of human blood is the blood cells. We call these red cells (erythrocytes) and white cells (leukocytes). The red cells according to Conley are *'highly specialized, well adapted for their primary function of transporting oxygen from the lungs to all the body tissues*.'[162] The white cells *'are nucleated and*

independently motile, highly differentiated for their specialized functions.'[163] The white cells have two subcategories under them — the 'granulocytes' and the 'monocytes.'[164]

The last component of human blood is the platelets, or the thrombocytes. These have a special task in the body:

> *'The function of the platelets is related to hemostasis, the prevention and control of bleeding. When the endothelial surface of a blood vessel is injured, platelets in large numbers immediately attach to the injured surface and to each other. This forms a tenaciously adherent mass of platelets.'*[165]

So then platelets are a specialized part of the human blood.

It would appear that even invertebrates have much the same kind of blood that humans and other vertebrates possess. The body fluids of the invertebrates are mostly *'aqueous mineral solutions containing all the principal salts of seawater.'*[166] The blood cells of the invertebrates are different from the vertebrates, in that some of the invertebrates may have copper instead of iron. It appears that the cells of the invertebrate blood *'are most generally leucocytes.'*[167] This will complete the short discussion on the components of the blood systems of the vertebrates and invertebrates.

The next topic of discussion is the different forms in which the blood may exist. We will start our examination of the invertebrate forms. The invertebrates do have iron based blood. In fact they have two kinds of iron based blood. One may observe the similarities between them *'because the prosthetic group of each is a cyclic tetrapyrrole by whose four nitrogen atoms it binds itself to one atom of iron.'*[168] The first of the invertebrate blood groups are chlorocruorins. One can state the distinctive of this type of blood and the distribution as follows:

> *'The ferroporphyrin of chlorocruorin called chlorocruoroheme, is unlike that of hemoglobin in that a formyl group is substituted for the vinyl chain in one pyrrole ring. The prosthetic group of chlorocruorin is identical with that of cytochrome a, the final enzyme in the oxidative chain. And in dilute solution gives fluids a greenish color, but a red one when concentrated. Chlorocruorins are very limited in their distribution among invertebrates and have been discovered in four families of polychaetes, but in 21 species in these families.'*[169]

As one can observe from this quotation, there is a difference between the hemoglobin and the chlorocruorin at the molecular level. It would appear as if the difference is not a substantial one, but major enough to have a different classification. The other iron based blood is similar to hemoglobin found in vertebrates. Yet some propose the difference exists for these reasons:

> *'While the prosthetic group was the same as that of vertebrate hemoglobin. The proteins were sufficiently different from vertebrate globin to make a distinction desirable and even necessary. The name erythrocruorin emphasizes the analogy of invertebrate hemoglobins with chlorocruorins. The proteins of each contain proportionately more arginine and less histidine than is characteristic of vertebrate globin.'*[170]

The invertebrate hemoglobin is similar to the vertebrate hemoglobin, yet not identical.

A second blood type found in invertebrates is hemerythrin. This too is an iron based blood, yet its distinction and distribution are noteworthy:

> *'But in them the iron is joined directly to certain amino acids, probably attached as side chains to the main axis of the protein molecule. Like the hemoglobins and chlorocruorins, hemerythrins can combine reversibly with oxygen. But in the combination one molecule of oxygen is united with three atoms of iron, not to one as it is in the porphyrin-containing pigments. Hemerythrins are even more limited in their distribution than chlorocruorins.'*[171]

One may note that this kind of blood exists within certain invertebrate animals. It also should be noted that this is a very poor oxygen carrier as compared with the previous two kinds of blood.

The last type of invertebrate blood is hemocyanin. This is distinct from the other groups in that this is a copper based blood. It also has some similarity to the hemerythrins, yet has some dissimilarities as well:

> *'In hemocyanins, as in hemerythrins, a metallic atom, here copper, binds directly to sites on amino acids of the chromoprotein. The copper, like the iron of the other three pigments, combines reversibly with oxygen, one molecule of oxygen bonded to two copper atoms.'*[172]

This is somewhat better at carrying oxygen than the other, yet not very much better. This has a large use by many invertebrates such as gastropods, cephalopods, arachnids, malacostracans and crustaceans.[173] The invertebrates have four different blood structures, each used well by those who possess it.

Of the blood structures found in vertebrates, the most well known is hemoglobin. One may describe hemoglobin in this manner:

> *'Hemoglobin is a protein; a molecule contains four polypeptide chains, each chain consisting of more than 140 amino acids. To each chain is attached a chemical structure known as a heme group. Heme is composed of a ringlike organic compound known as a porphyrin to which an iron atom is attached. It is the iron atom that reversibly binds oxygen as the blood travels between the lungs and the tissues. There are four iron atoms in each molecule of hemoglobin, which accordingly, can bind four atoms of oxygen. The complex porphyrin and protein structure may be considered to provide just the proper environment for the iron atom. This results in binding and releasing oxygen appropriately under physiological conditions.'*[174]

Another description with more detail is by Cherniack:

'The hemoglobin molecule has heme (a pigment) and globin (a protein). The globin portion of the molecule has four chains; two are identical A-chains, each with 141 amino acids. The other two are identical B-chains, each with 146 amino acids. In normal human hemoglobin (hemoglobin A), the component amino acids, the sequence in which they are arranged, and their spatial relationships are precisely known. In addition, the different amino acid compositions that characterize more than 100 variants of normal hemoglobin have also been determined. Changes in the amino acid sequence may affect the ability of hemoglobin to combine with oxygen. The four globin chains in hemoglobin contain one heme unit. Iron in the ferrous state is present at the center of each heme group; it can combine with one molecule of oxygen. Only when heme, iron, and globin are together in their proper spatial relationship can the combination with oxygen occur.'[175]

Thus hemoglobin is the efficient oxygen carrier for the vertebrates. There is also another type of oxygen carrier found in most vertebrate and some invertebrate blood, called myoglobin. Myoglobin is the second type of blood structure. We find this primarily in the muscle tissue. It may be described as follows:

'Myoglobin is a relatively small, oxygen-binding protein (MW 16, 700) found in muscle cells. It functions there to store bound oxygen and to enhance its transport to the mitochondria, which consume oxygen during oxidation of cell nutrients. Myoglobin contains a single polypeptide chain of 153 amino acids residues of known sequence and a single iron-porphyrin. Myoglobin is particularly abundant in the muscles of diving mammals such as the whale, seal, and porpoise. Their muscles are so rich in this protein that they are brown. Storage of oxygen by muscle myoglobin permits these mammals to remain submerged for long periods.'[176]

Here we have the various types of blood in both invertebrates and vertebrates. Each kind, it would appear, serves those organisms that use it very well. Now it remains to examine how various organisms use blood.

It would appear, at least to this author, that blood serves two major functions in any kind of life in which it exists. The first is the transport of food and waste products. This may be summarized in the following:

'A system of circulating body fluid is necessary for an increased body size, and an enclosed volume of fluid performs several general functions. These are: the transport of food materials from the gut to the tissues, the transport of excretory products from tissues to specific detoxifying centers or excretory organs.'[177]

This function depends on the blood in the bodies of those who possess it. This is also a necessary part of life, that being the transport of food and its waste products. Yet there may exist another major function of blood that deals with the distinctive nature of blood, that being transport of oxygen.

While the transport of oxygen is the other major emphasis of blood focused on here, there are more functions of blood, yet this is the most significant for the present argument. We call this function 'respiration'. We will examine this function later as it applies to respiratory structures, but we examine it here as it applies to blood.

Before continuing, it must be admitted that there are two kinds of respiration. The following definition illustrates this very well:

'The term respiration refers both to the process of cellular oxidation of foodstuffs to provide readily available energy. It also refers to the uptake and disposal of gases and their transport within the body.'[178]

The following discussion will focus only on the uptake and disposal of gases in the body.

This process of gaseous respiration may be described in the following:

'Respiration concerns the supply of oxygen to active tissues once it is inside the blood. In a creature the size of a human, the cells require about 250 milliliters of oxygen per minute. The blood would have to circulate through the heart at 180 liters per minute if the oxygen were in simple solution. In fact the blood flows at only about 5 liters per minute in humans. The presence of hemoglobin in the red blood cells allows more gas to be carried. This pigment carries both oxygen and carbon dioxide.'[179]

The Encyclopedia Britannica notes this process:

'In terms of immediate urgency, the respiratory function of the blood is most vital. A continuous supply of oxygen is required by living cells, in particular those of the brain. Deprivation is followed in minutes by unconsciousness and death. . . . Oxygen diffuses through the plasma and into the red cell combining with hemoglobin, which is about 95 percent saturated with oxygen when leaving the lungs. In tissues where the oxygen tension is relatively low, oxygen diffuses out of the blood. Not all the oxygen is removed, and the venous blood returning to the lungs is partially oxygenated. The added demand for oxygen during increased physical activity is met primarily by accelerated blood flow, permitting more oxygen to be transported. ... Carbon dioxide, a waste product of cellular metabolism, is transported by the blood in the opposite direction. Occurring in relatively high concentration in the tissues, it diffuses into the blood and is carried to the lungs for elimination by way of the expired air.'[180–182]

It seems that the invertebrates' respiratory pigment functions similarly to that of the vertebrates. Gardiner states this position well:

'Recognition of hemoglobins and other pigments in the blood and coelomic fluids of invertebrates have

> *raised the questions. If they, too, function in the same way? If they have some function, or possibly, if they have none at all. There are no grounds for assuming,* a priori, *that invertebrate hemoglobins perform in the same way that vertebrate hemoglobins do or that chlorocruorin, in spite of its chemical similarity to hemoglobin, acts as a respiratory pigment. The same reservations hold for the other pigments of invertebrate coelomic and vascular fluids. Investigation has shown, however, that invertebrate hemoglobins, chlorocruorins, hemerythrins, and hemocyanins do function as respiratory pigments, although in different ways and under different conditions.*'[183]

So then, one may conclude that invertebrates and vertebrates possess blood that does much the same task in terms of oxygen transport.

This discussion has emphasized that blood is important for life. The Scriptures teach that life and blood must exist together or not at all. The biological sciences echo the biblical statements about the importance of blood. We also must recognize that, while there are some substantial differences, in all animals that possess blood it is similar in function. Yet how does this relate to plants? We must seek to answer the following questions. Do plants possess blood, does it have the same function, and could we say that they are 'living' as illustrated by this parameter? We can observe that many 'lower' animals do possess blood, and the Bible says that they are 'living'. Many worms, insects, shelled animals use blood in a similar fashion as do humans. Therefore it would appear that these Tower' animals must be included in defining biblical life. Blood is an important parameter of life.

The sections that follow will examine the questions posed above. Here we will try to observe if plants have blood, how they use blood if they possess it. Lastly, we will try to observe if plants fit this parameter of biblical life.

It must be admitted at the outset that some plants possess some form of hemoglobin specifically termed 'leghemoglobin'. Irwin Ting observes this use:

> *'It seems logical to conclude that symbiosis creates a situation in which energy is supplied by the host, the legume plant here is Rhizobium. In the legume nodule, which appears red if cut open, there is a protein comparable to myoglobin called leghemoglobin.*'[184]

This quotation discusses the mutually beneficial relationship of a plant in the pea or bean family and the bacteria located on its root system. It is in the bacteria that one finds the leghemoglobin. There are plants other than the pea or bean family that possess this special fluid. Some have found leghemoglobin in a plant family called *Trema tomentosa.* Didier Bogusz says:

> *'Hemoglobin has previously been recorded in plants only in the nitrogen-fixing nodules formed by symbiotic association between* Rhizobium *or* Frankia *and legume or non-legume hosts. We report here the isolation of a hemoglobin gene from* Trema tomentosa, *a non-nodulating relative of* Parasponia. *The gene has three introns at positions identical with those in the hemoglobin genes of nodulating plant species. The* Trema *gene has a tissue-specific pattern of transcription and translation, producing monomeric hemoglobin in* Trema *roots.*'[185,186]

So one may conclude that the presence of hemoglobin exists over a large portion of the plant kingdom.

The function of hemoglobin in plants is uncertain at this point. Salisbury confirms this: '*leghemoglobin is thought to transport oxygen into the bacteroides at carefully controlled rates. Too much oxygen inactivates the enzyme that catalyzes nitrogen fixation.*'[187] Appleby supports Salisbury's point. He says '*the function of leghemoglobin seems confirmed as facilitation of oxygen flux to respiring* Rhizobium *at extremely low, nontoxic free oxygen concentration.*'[188] So, though the function of the leghemoglobin is uncertain, it does appear that the function is similar to the animal hemoglobin in that it transports oxygen.

Yet there are some vast differences between the function of the two hemoglobins. As we have noted, in animal hemoglobins there is both oxygen transport and carbon dioxide transport. This appears to be the missing ingredient in the plant hemoglobins, as Appleby illustrates:

> *'Nor is it likely that the ability of leghemoglobin to combine with carbon monoxide, or nitric oxide produced by nodule nitrite metabolism, represents an "intended" function of leghemoglobin, any more than the function of animal hemoglobin is to protect the body against inhaled or metabolically produced toxins.*'[189]

So then, one can observe that plant hemoglobin does not function in terms of the disposal of waste products produced by respiration as does the animal hemoglobin.

There is another major difference between animal and plant hemoglobin, that being the locality of it. We have shown that plant hemoglobins are in the root systems of plants that possess it. Yet when one notes its occurrence in animals, it traverses the whole body tissues or most of the body cavity. This illustrates perfectly what Leviticus 17:11 says, that the life of the flesh is in the blood. This speaks of something that runs throughout the body, not just one portion of the body. Thus the function of blood in 'living' things must be something that the whole of the flesh or muscle tissue possesses within it.

This brings us to answering the question; do plants possess this biblical parameter of life? The simple answer is no, plants do not possess this important parameter. The function and locality of plant hemoglobin is too different to argue that plants do possess biblical life. Many have tried to show that there is a long line of similarities between human and plant hemoglobin. They argue that the amino acid sequence is very similar,[190–201] and thus we

have molecular homology. They argue that they can trace the lineage back to a common ancestor gene. Yet this does not prove evolution or creation. All that this proves is that common form produces common function. So in all reality this can support either model of origins.

The third area of comparison between plants and animals relates to the above discussion on blood, yet the topic is specifically that of respiration. When discussing blood, we made the point that blood was necessary for respiration. The definition of respiration was the disposal and transportation of gases. The observation to be made here is that to have this type of respiration, one must have some structures that assist respiration. These structures are lungs, gills or other breathing apparatus.

Gas Exchange

This here will only be a brief overview of the apparatuses. A general statement regarding invertebrates may be found by Bauchsbaum. He says; *'many have specialized structures that provide increased surface for respiratory exchange with the surrounding air or water. In others, this exchange occurs over the body surface*.'[202] Gardiner examines five different structures; integumentary exchange, gills, water lungs, aerial lungs, and trachea.[203] One will search plant physiology texts in vain for any such structures. Yet when man and animals share this *ruach* it appears to imply gaseous exchange.

However, it is interesting to observe the usage of *neshamah* in this light. The Old Testament never uses this word referring to water dwellers. Still, those who possess this 'breath of life' inhabit the land and were the recipients of the judgment of God by the Flood. So, although *neshamah* is semantically related to *ruach* one cannot say this is part of the biblical parameters of life. This is true because God said of the *sheretz*, or swarmers of the sea, that they had life. So it would appear that this term *neshamah* would be instructive in terms of those animals that God brought onto the ark. God told Noah to bring also the *sheretz* of the land, so this would have been those small air-breathing insects. According to Genesis 7:21 *'Every living thing that moved on the earth perished'* and this includes the *sheretz* of the land. So then, one may observe that the term *ruach* is informative in defining biblical life, while the term *neshamah* is not. The term *ruach* refers to those that possess some sort of structure that helps in this gaseous exchange.

Consciousness

The fourth and final comparison will be that of consciousness as exemplified by the term *nephesh.* This comparison will examine the use of the nervous system. Consciousness may be defined as *'the knowledge of what is happening around one, the state of being conscious.*'[204] What we must examine is the following. What is the nervous system, and what are its component parts? How do these component parts function, and are there various forms of nervous systems? Then regarding plants, do plants have a nervous system, and how do plants make seemingly conscious movements? Once we have dealt with these questions then we should be able to draw some conclusions about what biblical life is, and possibly what organisms possess it.

The first thing we must do is to define the nervous system. Often we think of the nervous system in terms of its function. One might think of this function as a response to stimuli: *'The simplest type of living response is the direct one-to-one stimulus-response reaction. The change in the environment is the stimulus; the reaction of the organism to it is the response.*'[205] This may be used specifically related to animals:

> *'Because of the complexity of their physiological systems, all animals require a means of coordinating their activities and of adjusting their responses to external events. Animals therefore respond to stimuli, whether from within their bodies or from the outside world.'*[206]

The one thing these statements have in common is that both refer to response to stimuli. If this is the only determining factor, all biological life forms possess a nervous system. We may illustrate this by the following observations:

> *'In the single-celled organisms the response is the result of a property of the cell fluid (cytoplasm) called irritability. In protistan organisms, such as algae, protozoans, and fungi, simple responses in which the organism moves toward or away from the stimulus are termed taxes. . . . Plants respond to a variety of external stimuli by using hormones as controllers in a stimulus-response system. Directional movements are known as tropisms and are called positive when it moves toward the stimulus and negative when it moves away from the stimulus.'*[207]

Yet, as many openly admit, plants and many other biological life forms do not possess a nervous system. We may see this by:

> *'In animals, besides chemical regulation via the endocrine system, there is another integrative system called the nervous system. A nervous system can be defined as an organization of a group of cells specialized for the conduction of an impulse from a sensory receptor through a nerve network to an effector, the site at which the response occurs. Organisms that possess a nervous system are, therefore capable of much more complex behavior than are organisms that lack one.'*[208]

So one may observe that the definition of a nervous system must not be thought of in terms of its basic function (response to stimuli), but in terms of its makeup (specialized cells). Clearly, the use of a nervous system allows complexity of behavior.

Since the nervous system is to be seen in terms of its

component parts, these should be stated at this point. Our purposes here are only introductory, but we will discuss the neuron, and the synapse of the nerve. The neuron is the basic building block of the nervous system:

> *'These functions are performed by neurons, the cells from which nervous tissue are made that have specially developed properties of nervous conduction. Neurons come in many different forms, but their basic structure and function are the same in all animals*.'[209]

A good description of the complete nerve cell is the following:

> *'The nerve cell has a cell body and cell processes. There is a great variety of neuron types, depending on size, shape, and number of processes, and function. The cell body is composed of a more or less centralized nucleus and surrounding cytoplasm. The nerve cell processes are of two types: short, multiple processes are dendrites and a single, long process is an axon. Neurons with one process are called unipolar and are especially common in invertebrates. Bipolar cells have two separate processes. Multipolar cells have more than two processes, a single axon and two or more dendrites. Functionally, nerve cells can be classified as sensory, associative, or motor*.'[210]

The next part of the neuron is that of the nerve fiber:

> *'The nerve fiber has the axon and covering or sheath cells. In nerve conduction, the myelin sheath acts as an insulator that prevents the impulse from jumping to adjacent axons. The nerve impulse is a wave of excitation, called the action potential. This is formed by an electrical change, or depolarization, of the membrane of the axon and passes down the nerve fiber*.'[211]

The other area of the nervous system, covered at this time, is the synapse. The synapse '*is formed by the termination of an axon on the dendrites, cell body, or the axon of an adjacent nerve cell*.'[212] The transmission of the nerve impulse can be observed as:

> *'Transmission of the nerve impulse can either be chemical or electrical, but chemical synapses are far more numerous. In chemical transmission, a specific chemical is synthesized by the nerve cell, stored at the axon terminal, and released at the appropriate time, affecting the postsynaptic vesicles. Upon arrival of an impulse at the nerve ending, the neurotransmitter is released from the synaptic vesicles. The transmitter diffuses across the synaptic cleft and produces a change in permeability of the postsynaptic membrane. The change results in an electrical change in the postsynaptic cell. The effect on the postsynaptic neuron may be excitatory or inhibitory. After the neurotransmitter is liberated, the enzymes destroy it so that its effect is localized and of short duration*.'[213]

The synapses are those gaps between the different axons within the body. They function as a necessary part of the nervous system. The component parts of the nervous system are then the nerve cell and the synapse. We will be discussing other parts of the nervous system, but in the basal parts are these two.

The next question, although we have stated it variously above, is what is the purpose of the nervous system. The function in any system is very similar. This can be observed by contrasting the statements about the invertebrate and the human systems. The human system can be described:

> *'The nervous system can be viewed as an integrator that analyzes signals from the sensory pathways. This uses the information to generate command signals along the motor pathways to muscles and other effectors. The nervous system thus senses and analyzes the environment to generate behavior appropriate to that environment. All its interactions with the environment must pass through the peripheral units, which are sensory receptors or transducers and motor units, since these are the only interfaces between the nervous system and the environment.'*[214]

Concerning the invertebrate nervous system, Beklemishev says:

> *'Their* (the neurons*') function consists in more sensitive and acute reception of action by the external, and later by the internal, environment. They transmit the stimuli so arising to other neurons, and through the latter to those parts of the organism* (effectors) *that are capable of responding to a given stimulus by a reaction that is useful to the whole*.'[215]

So the function of the nervous system is to carry some sort of signal that will enable the organism to react to its environment.

One would do well to observe the complex nature of the nervous system in general. One can see this general complexity of the nervous system because '*the complexity of a given nervous system is related simply to the way these units are linked together.*'[216] Here we will examine the various types of nervous systems, from the very simple to the very complex. The more complex the system becomes, it appears, the more complex the behavior becomes also.

The nerve net is the most simple of the nervous systems. As Gardiner describes it:

> *'The nerve net as a pattern of neural organization is best known in cnidarians and in asteroids, whose dermal branchiae are innervated through a demonstrated nerve net. The criterion of a nerve net is that conduction in any direction should be possible, the excitation spreading among the neurons adjacent to the point of simulation in a nondirectional, nonpolarized fashion*.'[217]

Lentz has this to say about the nerve net:

> *'The common hydroid* Hydra *has a nervous system that consists entirely of a nerve net. This is a meshlike system of individual and separate nerve cells and fibers dispersed over the organism, but more concentrated near the "mouth". This widespread*

arrangement of fibers allows diffuse conduction of nervous excitation over many available pathways. So, if a hydra is split longitudinally but left connected by a small piece of body wall, stimulation of one side will result in contraction of both sides.'[218]

Thus, the nerve net will allow reaction on both sides of the body when stimulated on only one side. The system is very diverse over the whole body with no real centralization. There is no 'complex behavior' exhibited by those that possess the nerve net.

The next system could be termed 'radial systems'.

This system is a step up from the nerve net:

'In radially symmetrical animals, such as coelenterates and echinoderms, there is a diffuse nerve net over the whole body. In many coelenterates there may be longitudinal tracts of nerves to help withdrawal of tentacles. The echinoderms have a dense ring of nerves around the mouth.'[219]

Lentz observes this about the simple and complex radial systems:

'The nervous system of coelenterates, which corresponds to the radially symmetrical bodies of these animals, is distributed over the surfaces as a nerve net. The jellyfish of the class hydrozoa have two circular thickenings of the nerve net near the margin of the bell. These thickenings are the nerve net rings. From the nerve rings, other thickenings of the net extend inward toward the mouth. ... A complex radial nervous system is found in the echinoderms, which, like the coelenterates, have a radial type of body construction. The major components of the complex radial system are a nerve ring around the mouth, radial nerves extending into the arms, and a nerve network or plexus, neath the body covering. The radial nerves and nerve ring are the central nervous system of echinoderms. These are actually thickened regions of the nerve cells and fibers.'[220]

The final person to comment on this system is Beklemishev:

'The diffuse neural apparatus of coelenterates is a very primitive type. It is not divided into central and peripheral sections. There is no specialization among the associative cells, and there are no long conducting routes consisting of single processes. The network conducts stimuli in all directions, the stimuli being passed from neuron to neuron. Simultaneously each of them is also connected with motor cells. Therefore a wave of excitation spreading through the nerve plexus from any point is accompanied throughout its journey by a wave of muscle contraction.'[221]

The radial systems are simply, complex nerve nets. They do have some move toward a centralization, but very little. The movements of these animals are much like a wave action, not a complex composite of actions. The behavior of these animals is also very simple, nowhere near the complex behavior of the 'higher' animals.

The next type of system is a bilateral nervous system.

This system may be described as follows:

'In bilaterally symmetrical animals the tendency to concentrate the nervous system into tracts is clearer. Most invertebrates have a ventral nerve cord, generally formed from a fusing of two or more embryonic nerve cords. In segmented groups, each segment of the animal commonly possesses a concentration of cell bodies called a ganglion. These contain many synapses, and the axons to and from receptors and effectors are arranged segmentally in a repeating pattern.'[222]

Lentz adds the following comments:

'The flatworms were the first invertebrates to exhibit bilateral symmetry and the first to develop a central nervous system and a brain. Located in the anterior portion of the animal, the brain is composed of two cephalic ganglia joined by a broad connection called a commissure. Longitudinal nerve cords, usually three to five pairs, extend posteriorly from the brain; they are connected by transverse commissures, and smaller, lateral nerves extend from the cords. The lateral nerves give rise to the peripheral nerve plexuses.'[223]

Gardiner adds this concerning the bilateral system:

'In flatworms there are longitudinal nerve cords. In some, acholous species there are five pairs of these, situated dorsally, dorso-laterally, laterally, ventro-laterally, and ventrally. Even in primitive Acoela, *where the entire system is in a pattern of a plexus, there is a concentration of nerve cells in the anterior region. This forms a fairly compact mass constituting a cephalic ganglion or "brain", which is an important center of neural activity.'*[224,225]

So it would appear that the bilateral system is much more complex than the nerve net and radial system. Yet as one examines the schematic illustrations of how this system is structured, one will observe that much of the nerve processes are not centralized but very much localized. Most of the nerve mass is still contained in the outer structures of those animals that have the bilateral system. As we have stated before, the more centralized the nervous system, the more complex the behavior. This author has not observed anyone discussing the behavior of those possessing the bilateral system, but he suspects the behavior is not very complex. Once we leave this system the behaviors start to become complex, depending on the animal.

We proceed from the bilateral system to those that are cephalized. Lentz divides this classification into two parts; moderate and complex systems. Those comprising the first category are the annelids and simple mollusks. Lentz describes the basic annelid system as:

'The brain of most annelids (terrestrial earthworms and the leeches) is relatively simple in structure. The annelid brain is a bilobed mass lying above the pharynx in the third body segment. The most primitive

annelids have a pair of ventral nerve cords joined by transverse connectives. The more advanced forms have the cords fused to form a single cord. A ganglionic swelling of the cord is found in each body segment, with the most anterior ganglion being the most prominent. Two to five pairs of lateral nerves leave each ganglion to innervate the body wall of that segment.'[226]

Lentz also has a discussion regarding the interaction of the nervous and muscle systems. He notes the activity of locomotion:

'The usual slow crawling movements of worms are mediated by a series of reflex arcs. During crawling, the contraction of muscles in one segment stimulates the stretch receptors in the muscles. Impulses are carried over sensory nerves to the cord causing motor neurons to send impulses to the longitudinal muscles, which then contract. The longitudinal pull starts the stretch receptors in the following segment, and a wave of contraction moves along the worm.'[227]

Regarding the simple mollusks Lentz observes:

'The nervous systems of the lower mollusks (snails, slugs, and bivalves such as clams and mussels) conform to the basic annelid plan. Yet they are modified to conform with the unusual anatomy of these animals.'[228]

One may note the contrast between the moderate and complex groups appears to be large. Many descriptions also include comments concerning the behaviour patterns of those within the complex group. Lentz gives the basic description:

'Although the basic plan of these nervous systems is similar to that of the annelids, there are several advances. First, there is a high degree of cephalization, with nervous functions concentrated in the head region of the animal. In addition, ganglia are fused and further forward. The nerve cells, less abundant in the peripheral nervous system, are in the brain or ganglia so that the nerve cords consist only of nerve fibers. Finally, control and coordination of specific functions, such as locomotion and feeding, are compartmentalized in particular parts of the nervous system.'[229]

All the animals that the Bible describes would fit into this classification. Even some that the Bible does not specifically tell us about also may be found in the complex group.

The cephalopods (such as squids and octopuses) are among this group. Meglitsch describes the animal:

'The cephalopods have the most highly developed nervous system to be found in invertebrates, and correspondingly complex behavior patterns. Masses comparable to the cerebral pedal, pleural, and visceral ganglia can be recognized, but the ganglia have lost their integrity as individual ganglia. They have been subdivided and assembled into a circumenteric nerve center, functionally a complex brain.'[230]

One may observe that Meglitsch links the complex brain with complex behavior. Thus the cephalopods are among the complex group.

The next group is the arachnids. Meglitsch says that *'the nervous system is very strongly concentrated in arachnids generally. The brain, connectives and subesophageal ganglia are fused to form a complex nerve ring.'*[231]

He continues to comment regarding the complex behavior of arachnids:

'Generally, arachnid behavior patterns are complex. They burrow, build nests, construct webs of varying complexity and precision of design, indulge in courtship rituals, and carry out a variety of complex activities.'[232]

The spiders and scorpions also may be placed in the group of complex nervous systems.

The last group to be dealt with is the insects. Meglitsch describes the advances of their nervous system:

'Outstanding developments are first, continued progressive specialization of the brain, with the formation and development of specific nuclei and relay centers. Second, centralization of the nervous system by anterior migration and coalescence of ganglia on the ventral nerve chain. Third, the lengthening of the peripheral nerves to compensate for the new position of ganglia.'[233]

He also comments on the remarkable behavior of this group:

'The complex nervous system of insects is the structural basis for interesting and diversified behavior patterns. No group of animals is more interesting from a behavioral point of view. Some of the most striking developments in behavior are seen among the social insects.'[234]

One could rightly conclude that the insects are a complicated group because of their complex nervous system. The nervous system of the invertebrate becomes complex, and this in turn allows for complex behavioral patterns.

Plants exhibit behavioral patterns, in that they have movements in response to various stimuli as pointed out previously. The first is that of solar tracking or phototropism. Salisbury says of this:

'To begin with, solar tracking is a true tropism, because the orientation of the leaves is determined completely by the direction of the sun's rays. Nevertheless, the orientation of the leaves is controlled by motor cells in a pulvinus where the blade joins the petiole. Movement of water in and out of these motor cells is completely reversible — and almost certainly controlled by osmotic solutes. That is, solar tracking is not a growth phenomenon as are some other tropisms.'[235]

Something similar can be said of the Mimosa plant: *'Leaflet movement is caused by water transport out of*

certain motor cells of the pulvinus.'[236] These types of movements are called non-growth turgor movements. Ting says this very well:

> *'They (the turgor movements) are reversible, occurring because turgor changes in specialized cells or regions. The very rapid closing of the leaves of the Venus flytrap in response to insect touch is a good example. Another good example of turgor movement in plants is the sun-tracking phenomena of certain flowers and leaves throughout the day.*'[237]

One might rightly ask about how the stimuli are transported through the plant. There appear to be two different means of transporting the stimulus. They are known as action potentials, the first being electrical. Salisbury notes:

> *'The electrical fluctuation is an action potential, which is a change in voltage that forms a characteristic peak when plotted as a function of time. Action potentials in* Mimosa *are similar to those occurring in animal nerve cells but much slower. They apparently travel through parenchyma cells of the xylem and phloem at velocities up to 2cm* s^{-1}*, whereas action potentials travel along nerve cells at velocities of tens of meters per second.*'[238]

One may observe that the transportation of the stimuli, although electrical as in animals, is done through the water system of the plant and not through specific cells designed to transport the stimuli. This could account for the difference in speed in actual neurons.

The second means of transporting the stimulus is chemical. It would appear that the Venus flytrap is a good example of this. Again Salisbury states:

> *'A few well-studied examples in which an action potential is obviously useful to a plant is the excitation by an insect of one or more sensory hairs of the Venus-flytrap. Action potentials move into the bilobed leaf and cause the lobes to snap shut within a half second or so. In the Venus-flytrap studies have shown that the rapid closing is another example of acid growth. Hydrogen ions are rapidly pumped into the walls of cells on the outside of each leaf in response to the action potentials from the trigger hairs. The protons apparently loosen the cell walls so rapidly that the tissue actually becomes flaccid. This results in the cells quickly absorbing water, causing the outside of each leaf to expand and the trap to snap shut.*'[239]
>
> The hormone auxin causes the chemical aspect of the response. The effect of auxin may be stated as follows:
>
> *'Auxins cause the receptive cells to secrete* H^+ *into their surrounding primary walls and that these* H^+ *ions then lower the wall pH so that wall loosening and growth occur.*'[240]

It would appear that the Venus flytrap uses chemical means to carry the stimuli rather than electrical means.

One must ask then if plants possess a nervous system that causes the various movements we perceive. The answer to that question is a strong negative. Plants do respond to stimuli, which is similar to the function of a nervous system (to produce the response), but they do not possess such a structure. Thus plants fail on this fourth parameter of biblical life.

This conclusion gains strength when one examines the so-called evolution of the nervous system. Plants are conspicuously absent from the discussion. Sarnat introduces the evolution of the nervous system in the following manner:

> *'Evolution is change. The constant features of the nervous system of vertebrates are structures that have failed to evolve or change appreciably. They offer insights into the origin of the brain, but the differences among species denote evolution. The limited range of function available to animals using simple nervous systems affords an understanding of their limitations. This gives an appreciation of the refinement and supplementation in more complex species. The observation of simple vertebrates also brings an awareness that the brain of man resembles the brains of "lower" animals more than it differs from them.*'[241]

One finds no mention of plants in the above quotation nor in any of the discussion in the book. Sarnat starts with invertebrate animals and omits the plant kingdom totally.

Even in the evolution of the nervous system, homology is a major line of argumentation. Observe the discussion in Sarnat:

> *'Homology is the study of comparable anatomic structures in different species; these structures can be traced in evolution to a similar structure in ancestors. The frequent adaptation of homologous structures to new functions in later species limits the definition of homology to one of structure and excludes function. Criteria for establishing homology differ with various organ systems. . . . In view of these variations, homology of central nervous structures is based on fiber connections and relations to other structure. Another approach to the problem of homology in the central nervous system of vertebrates is based on the premise that specific chemical neurotransmitters remain unchanged in homologous neural structures during evolution.*'[242–245]

Again, we might ask what homology provides the interpreter of scientific data. It provides neither proof for nor against evolution. It shows that common use will require common structures. It does not provide the transitional evidence from one species to another. This must be supplied by the bias of the interpreter. Homology then, is really silent in the creation/evolution debate. Yet this is a main line of evidence used by those whose bias is evolution.

SUMMARY

The presentation of the 'evidence' above may have

seemed disjointed as it discussed the question of 'what possesses life?' Yet the reader was to have thought of himself as a detective, trying to uncover all the clues from the Scriptures that pertain to the topic. It is now time for the detectives to step back from the clutter of the clues and look at the whole picture of what possesses 'life'.

The discussion of the boundaries of 'life' were four in total. The first was that of 'soul' or 'consciousness'. It was determined that both animals and men possess these traits. The second boundary was 'flesh' or 'muscle'. The Hebrew and Greek words apply only to humans and animals. Spirit or breathing, as the third parameter, exist in animals and humans. The final limit, 'blood', was linked with 'flesh' and 'soul'. The Bible uses this strictly for humans and animals. All of these various characteristics must be possessed for something to be considered 'living'. Throughout the biblical text a combination of these words may be used as a metonymy for all four. Yet the Bible nowhere gives any of these parameters of 'life' to plants.

This consideration, 'what possesses life according to the Bible', is important for two reasons. The first reason relates to the existence of death, suffering, the food chain, and scarcity in the finished creation. It would seem, in the light of the boundaries of 'life', that plants are not 'living' according to the Bible, and, therefore, could not have 'died' when they were eaten by animals or man in the Garden of Eden. Since God is not the creator of death, it must have entered subsequent to the finished creation. The God of the Bible is a good, loving, holy, and omnipotent God.

The second reason why this topic of a 'biblical definition of life' is important, is that man needs to have his thoughts in subjection to those of God. If this is not done, then man condemns himself to error in some form or to some extent. This is symptomatic of all the various compromising positions regarding biblical creation taken today. One can observe this pattern in the following quote:

> *'A close examination of the text reveals that only two Hebrew words are used in the Genesis flood account to refer to the animals destroyed by the flood and to those taken aboard the ark. The words are* nephesh *and* basar. *The word* nephesh *translates as 'soulish' animals endowed with characteristics of mind, will, and emotions, creatures with a unique capacity to relate to humans. We call them mammals and birds. It is their soulishness which makes them particularly susceptible to the effects of man's sin. The word* basar *refers more specifically to those birds and mammals that are part of man's economic system, that is, to livestock, poultry, game animals, any birds or mammals that have had contact with man.*
>
> *So, the animal species rescued via the ark were* nephesh, *particularly those in the category of* basar, *living within the reach of the flood's devastation.*'[246]

Hugh Ross is dealing with the topic discussed in this article. He appears to accept the modern idea of 'life'.[247] He then adjusts his understanding of the biblical text to match that idea. Once this is done, modifying what the Bible says about Noah's Flood is simple. He also believes that there was death, suffering, and scarcity in existence when God finished the creation. Ross goes on to say it was only those animals, around man, and man himself that died during the localized, not global, Noah's Flood.

This is a good example of the error of man's own thinking, because the Bible says much more concerning the *basar* and *nepes* than Ross is willing to acknowledge. The Bible uses these words of small creeping things (Hebrew: *remes*). This word occurs a total of 17 times in the Old Testament, and includes both aquatic and land creatures. God uses this word in Genesis 1:20 where He creates the sea life, and says that this group too is part of the 'living'. It occurs again in Genesis 1:24 among the land animals. Here too, God gives this group the status of 'living'. God includes this group in the vegetarian diet of Genesis 1:30 with the beasts and birds. This word *remes* is significant because it denotes a variety of living things. Psalm 104:25 suggests that there are innumerable *remes* in the seas. 1 Kings 4:33 (5:13) and Ezekiel 38:20 suggest that this could speak of rodents and reptiles. Leviticus 11:20–44 signifies rodents, snails, reptiles, insects, spiders as all who qualify as *remes.* Even more specifically, Leviticus 11:9–12 says the *remes* in the water have *basar.* So it would appear that biblical 'life' then must extend to at least the insect world.[248,249]

CONCLUSIONS

We started out to examine if plants had biblical life and so we discussed the biblical parameters that define a 'living' thing. The first parameter was *nephesh.* The Old Testament associates this Hebrew word, as usage shows, with consciousness. Man and animals are the focus of this word. We investigated this parameter in the biota. It seems likely that we may link this word to the nervous system. Here too animals only possess a nervous system, plants do not. The second parameter was *basar.* The meaning of this term is flesh. The Old Testament uses it referring to man and animals. As we observed the biota, it seems that this word is comparable to striated muscle tissue. Here too, this word never refers to plants. The third parameter is that of *ruach.* This word may refer to respiration or gaseous exchange in man and animals. Yet it never says that plants possess this characteristic. As we found in the biota, the third and fourth parameters must function together. This fourth parameter is blood. Blood, as we saw, is the means of transport for oxygen in animals and man. Without the blood to exchange gases, and to distribute nutrients, the animal or man dies. Blood is very important to the sacrificial system of the Old Testament. In fact the blood represents the life of the individual. Plants do possess a type of hemoglobin in the root system,

and the purpose is similar. But the blood, as a biblical parameter of life, must flow throughout the organism as the Bible states in Leviticus 17:11. So one can rightly conclude that plants do not possess biblical life. If they are not 'living' then the animals eating plants in the original creation would not cause death to occur.

So then, what possesses 'life' according to the Bible appears to have certain parameters. They are: consciousness, flesh, breathing, and blood. The Bible clearly includes those life forms that possess these parameters.

The question might then be asked: which animals in the biota have biblical life and which do not? This is a very difficult question to answer, for there is a vast gray area (at least as this author perceives it) in our knowledge. We can see from the biblical text that all vertebrates have biblical life. We have concluded that plants do not have biblical life. We may also say the single-celled life forms do not qualify for biblical life. The problems one encounters is in the remainder of the invertebrate group. There are still many things unknown about this group. It seems that we must wait patiently until we have more data to work from in answering this perplexing question.

Nevertheless, according to the Bible the 'living' things include insects, mollusks, fish, crustaceans, spiders, reptiles, amphibians, birds, mammals, and humans. Humans, who are God's special creation, possess a much more diversified collection of these traits, but all 'living' things will have them in common. As suggested at first, some say that plants are also to be classed in the category of 'living'. Yet the Bible never ascribes to plants the attributes of a 'living' thing. Since they are not 'living', they could not die when consumed. Death occurred in the world only after man sinned and God cursed His creation.

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