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Can Protozoa Prove the Beginning of the World?

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Abstract

Protozoa are magnificent creatures. They exhibit all of the functions intrinsic to living organisms: irritability, metabolism, growth and reproduction. Within these functions, there are numerous examples of mutations that occur in order for organisms to adapt to their given environments. Irritability is demonstrated in protozoa by their use of pseudopodia, flagella, or cilia for motility; it has been shown that such locomotors exhibit diversity while maintaining similar protein and chemical structures that appear to be a result of evolutionary processes. Metabolism in protozoa is similar to that of larger animals, but their diet is unique. They primarily feast upon bacteria, which have begun mutating to evade easy ingestion and digestion by protozoa, therefore increasing their survival rate and making it necessary for protozoa to adapt. Reproduction naturally follows growth in protozoa, and these processes are quite unique from larger life forms, leading scientists and evolutionists to hypothesize that the cenancestor that is pivotal in their case was a sexual being. Mutations that take place through sexual or asexual reproduction, when repeated over several generations, can eventually lead to a new species, which is the main doctrine in the theory of evolution. Creationist arguments that attempt to dissuade believers in theistic evolution rely heavily on the account in Genesis 1, but have no empirical evidence from the study of protozoa for their theory. On the other hand, numerous studies related to protozoa have been devoted to the proof of evolution. To summarize all of this, the study of protozoa, in its current state, may lead one to the reasonable conclusion that evolution was the process by which God formed the world.

Can Protozoa Prove the Beginning of the World?

How did the world begin? Did God speak everything into existence and specifically create each organism? Or did He merely begin the process and allow all organisms to evolve of their own accord, and as dictated by their environment? Did this gradual progression occur mindlessly and free of God's guidance, or was God directing it? There are many questions such as these that people have wondered about the origin and formation of the world as it is known today, questions they seek to answer with either creationism or evolution. Whatever conclusion they come to, everyone is consumed by the same problems: "'why are we here?' and 'what is the universe and why is it here?'" (Berry et al., 2007). These questions ought to be studied and answered with reasoning and evidence. How, then, should one go about such an investigation and analysis of how the world began?

Many studies focus on evolution or creation in light of humankind. Might this be a good place to begin the analysis? A recent Gallup survey asked individuals about their beliefs related to this particular topic. The majority recognized God as having played a part in the process, with 40% voting that God created humans in present form, and 33% voting that God guided evolution (Gallup, 2019). However, this statistic deals primarily with the phenomenon of human development. Even the Genesis account concedes that all other creation preceded mankind. Therefore, it would be much more beneficial to examine a more primitive organism, such as the protozoon in all of its distinguished forms, which are collectively known as protozoa. The study of the functions in protozoa – irritability, metabolism, growth and reproduction – will lead to a reasonable conclusion: theistic evolution is backed by the most and the best evidence.

History of the Study of Protozoa

For years, people considered protozoa to be the most simplistic living organism. Today, scientists are much more aware of the complexity of a protozoan organism, but it should serve as a good tool in considering the origin of life through evolution or creation. Additionally, the diversity among protozoa should allow for a well-rounded discussion of various points of conflict. It is difficult to provide a definite number of accepted species within the kingdom, as different classification systems organize species in different ways, but there are easily several thousand species that can be classified as protozoa. For decades, scientists have found it reasonable that protozoa evolved from various parasitic organisms and prokaryotic cells (Bhatia, 1936, p. v; Calkins, 1901, p. 4; Cavalier-Smith & Chao, 2003, p. 542). Nevertheless, this does not deny the possibility that God specially created these organisms.

The first recorded observation of protozoan organisms is credited to Anton van Leeuwenhoek in 1675, when he documented his findings and explained his idea that these animalcules were complete organisms with all of the complex organs and life functions that are present in larger life forms (Calkins, 1901, p. 5). Over the years, scientists made amendments to this research as imagination was reformed by observation, exemplified by the experiments that demonstrated the impropriety of the theory of spontaneous generation, and therefore allowed researchers to uncover more about protozoa.

Carolus Linnaeus included protozoa in the twelfth edition of his *Systema Naturae* in 1767, after years spent in skepticism over the existence and animation of such an organism (Calkins, 1901, p. 7). In 1786, Otto Friedrich Müller followed the classification system established by Linnaeus to describe some three hundred species that were, at the time, considered protozoa. In addition to classifying his own discoveries, Müller organized the existing species and assigned scientific names to each of them as Linnaeus' system dictated. During the late 19th

century, Otto Bütschli created his own taxonomic system to organize the species discovered up to that point. He used comparisons of various characteristics and an understanding of evolution's progression from simple to complex in order to add higher taxa (Lynn, 2011, p. 2). Many consider Bütschli to have made the greatest contributions to the study of protozoa during the 19^{th} century.

While scientists like Müller and Bütschli were working to classify more species in order to increase the diversity of the study of protozoa, others such as Bonaventura Corti, Lazzarro Spallanzani, and Wilhelm Friedrich von Gleichen-Russworm were most interested in learning about protozoan physiology. These three contributed especially to ideas about the contractile vacuole, which is a "liquid-filled organelle, serving as an osmoregulator in the cytoplasm" (Lynn, 2011, p. 24) that pulsates regularly. This vacuole is essentially a mouth through which protozoa can ingest food and respire. Research like this over the past several hundred years has helped scientists to understand the life of a protozoon and its various functions. Technological innovations in the twentieth century enabled clearer and greater magnified observations, which led to a comprehension both broader and more in depth.

One of the most important discoveries that impacted the entire study of protozoa took place in 1838, when Matthias Jacob Schleiden and Theodor Schwann established the cell theory (Calkins, 1901, p. 6). Leeuwenhoek and some of his contemporaries had believed that protozoa were complete organisms with all of the complexities of higher creatures like humans. Others thought that they were simplistic blobs, exactly as they looked in the microscope. How could something so small have individual organs? The cell theory synthesized these two camps. The cell theory established the idea that the cell can be a part of an organism, or it can be a whole and fully functioning organism. Scientists considered this to be significant, as it led to the deduction that the animalcules discovered by Leeuwenhoek behaved like other living organisms.

Theistic Evolution and Special Creation

While scientists have spent millennia studying the organisms in the world, many others have sought an origin story for these organisms. There are thousands of different cosmogonies, yet most are rooted in some form of creation or evolution. Creation "is the old theory" (p. 7), as J. T. Sunderland (1902) explains in *The Spark in the Clod*, and is a sharp contrast to the new theory represented in evolution. He declares the various legends of the origin of the world, citing stories from African tribes, Indian religious groups, Chinese empires, Greek city-states, and ancient Persians – all of which were rooted in the idea that something or someone, often a powerful entity, had formed and established the world. The stories from different cultures recount the creation of the world in beautiful terms, but are they simply poetic myths? Could one of these tales accurately portray how the world began? Or are they simply legends, "creations of the imaginative faculty of men asking themselves" (Sunderland, 1902, p. 12) questions about their origins? The account found in Genesis 1, in which the Judeo-Christian God spoke the universe into being over the course of seven days and called it good, is revered by many fundamentalists as a factual representation. Mutations that may have occurred since are a result of the Fall, and "God cannot therefore be blamed for poor design of the human body or for anything else that goes wrong in the world" (Berry et al., 2007). This is a highly condensed summary of the ideas that fall under creationism.

It is important to note that some creationists have examined the world and concluded that creation is the most reasonable cosmogony. The definition of science has evolved with the increased interest and acceptance of modern evolutionary theory. Where ancient cultures relied on deities to explain parts of creation that they did not understand, modern society has found explanations in laws and scientific understanding (Muehlenbein, 2015, p. 16). Nevertheless, most of the argument revolves around a summons to go and observe the world, for it could not come about unless it was specially created by a god. The large argument in favor of creationism, even that part of it that is supposedly based on scientific inquiry, is that evolution could not achieve such a world. It is true that evolution from a pool of slime or a colossal explosion are far-fetched ideas. Nonetheless, it is far-fetched to believe creation simply because of the beauty of the world, especially when there are countless scientific studies demonstrating evolution taking place today.

As opposed to creation, evolution appears to be rooted in science. Since Charles Darwin established his evolutionary theory, more and more scientists have come to understand his reasoning or to build upon his theory by examining other organisms and applying the basic theories to their research. Those scientists and researchers who were limited by technology during their time encouraged future generations to continue the research and learn more, as “a systematic survey is likely to furnish a clear understanding” (Bhatia, 1936, p. v) of all life and how evolution may have occurred. In fact, that is the most they can do, is to speculate how evolution may have happened, at least until there is conclusive evidence that demonstrates how evolution occurred at each point along the process. Evolution was not originated to attack creationism, as some people may feel, but because it “accurately described the variation and diversity of animals and plants, both living and extinct” (Muehlenbein, 2015, p. 4). Where creationist cosmogonies were largely written to poetically convey the beginning of the world, the theory of evolution was originally written and has continued in popularity for its success in explaining the formation of the world while providing for various confounding mutations that were clearly evident.

The battle between evolutionists and creationists has been prevalent since Charles Darwin published his *Origin of Species.* The two theories cannot coexist, even when considering evolution as an operation guided by God. Evolution involves “changes in the genetic constitution of a population of organisms [that] generate biological barriers to gene exchange, resulting in speciation” (Muehlenbein, 2015, p. 4). Many people elect to distinguish between two types of evolution: diversification within the same species, and modification resulting in a new species. Creationists have no qualms with accepting the former, possibly because they cannot deny scientific evidence, but draw the line before acknowledging the latter. Likewise, evolutionists, especially theistic evolutionists, are quite at ease with accepting microcreationism, or creation of specific systems like the flagellum, as such a creator would surely not devote time to creating “each particular instantiation of a flagellum” (Eller, 2003). Microcreationism does not naturally lead to creation as outlined in various religious texts, but there is evidence leading to macroevolution from incremental mutations.

It is important to establish a few things before delving into this analysis. First, for the purpose of this analysis, God exists. Evolutionary theory offers many arguments against the existence of God, but for the simplicity of the argument, these will not be examined here. While evolution is commonly considered to be an atheistic idea, and creationism a Christian one, they can both align with the existence of a god. In fact, the existence of God fulfills the main issue people encounter in the consideration of evolution – how did the process begin? Quite simply, God set it into motion, as the “conception of creation as continuous and eternal” (Sunderland, 1902, p. 3).

Second, and following from the first, intelligent design was a part of God’s formation of the world. While there are other difficulties when one really tries to understand the concept, it is easy to believe that God was indifferent to the formation of the world, and evolution happened in the exact way that many atheists believe. Conversely, the Judeo-Christian God is said to have created humankind specially and with a purpose. He formed all other organisms with the same cells, the same basic life functions. Even if he established the world for his own entertainment or in a momentary lapse in judgement, the world follows observable and consistent natural laws, which random and true evolution as practiced by atheists could never accomplish. At its core, intelligent design describes the idea that some entity designed the world. To accomplish such a feat, this entity must have intelligence. Even the worst design can be created and carried out by someone with intelligence. Intelligence is required in order to design something.

All Christian positions on the evolution versus creation debate are based upon intelligent design. The disagreement comes when the various camps begin to discuss God’s method of execution. Special creation and theistic evolution are considered to be the overarching ideas. From them, there are various interpretations of the possible method by which God designed the world. These interpretations, depending on how one stumbles upon them, can drastically influence how one views God. As will soon be seen, the study of protozoa leads to the conclusion that theistic evolution is the most reasonable cosmogony.

Life is the center of the argument, regardless of the side one chooses. How did it begin? By examining the different functions characteristic of living organisms, it is possible the evidence will begin to clearly point towards a single superior cosmogony. These functions “are generally considered to be organization, metabolism, growth, irritability, adaptation, and reproduction” (“Life.,” 2020). Organization and adaptation are characteristics that will be seen through the analysis of each of the other functions, so there will not be a specific section devoted to them. However, irritability, metabolism, growth and reproduction will each be discussed in depth for both sides of the argument.

Irritability and Locomotion

The simplest characteristic to examine in this analysis may be irritability, which is "response to stimuli" ("Life.," 2020). Various internal or external cues may induce such a response, which shocked scientists in the twentieth century who believed that protozoa only evinced random motion and found that this motion is commonly influenced by a sense of direction (Bosgraaf & Van Haastert, 2009). An example of irritability prompted by external cues can be seen in the interactions between a protozoon and one of its main predators, a mosquito larva (terHorst et al., 2010). If the protozoon is at rest in water and a larva begins to hunt, it will react by seeking refuge and attempting to swim away. This response can transpire in different ways, but the three most common ways for protozoa are demonstrated through locomotor organelles such as pseudopodia, flagella, or cilia.

Pseudopodia, from the Latin and Greek meaning false feet, are "temporary protrusions of the cell, associated with flowing movement of protoplasm, functioning in locomotion and feeding" (Maggenti & Maggenti, 2005, p. 767). Pseudopods are different from other locomotor structures in that they are impermanent, forming for a specific purpose and eventually retracting into the cell body. "The frequency, position, and directions of the maintained pseudopodia form the basis of cell movement, because they determine the speed and trajectory of the cell" (Van Haastert, 2010). These processes can grow in different shapes and lead to distinctive movements among different species, typically either slow and consistent or bursting and sporadic. Additionally, some species extend pseudopods from existing processes, while others extend them from the cell body. Splitting, as in the former, is typically performed similar to the way humans walk – right, then left, then right again, and so it continues.

Other protozoa, especially those that live in the water, move using flagella. A flagellum is a term used for “any of various whiplike appendages” (Maggenti & Maggenti, 2005, p. 376). Like human hairs, flagella have growth and rest periods, and they can grow simultaneously or distinctly (Bertiaux & Bastin, 2020). The way in which flagella whip or wave about to elicit movement varies drastically from species to species, so it is difficult to establish a pattern. However, there are several movements that are common. Some have mastigonemes that cause movement to flow in the direction in which the flagellum points, while others move opposite to the direction of the flagellum. Their form can be “flexible, others rigid; some are straight, others curly” (Pallen & Matzke, 2006).

Like flagella, cilia display movement are a result of “the sliding of microtubules in the shaft against each other” (Thorp et al., 2001, p. 47). There are many who believe that the similarities between the two structures can demonstrate evolution, as they share the same ultrastructure of microtubules (Ochoterena et al., 2019; Thorp et al., 2001, p. 47). This is, however, where the similarities end. Cilia are “vibratile, hair-like processes” (Maggenti & Maggenti, 2005, p. 201) that are much shorter than flagella, and as a result, their function is unique. While flagella could be said to move in a graceful wavelike fashion, cilia move more rapidly. Ciliary movement is metachronous, with each cilium “slightly out of phase with its neighbors” (Thorp et al., 2001, p. 47). Beyond locomotion, cilia can be found on a wide variety of protozoa as sensory organelles.

In his book, *Darwin’s Black Box*, Michael Behe (2006) defends special creation by examining the mechanics of the flagellum, claiming that it, along with the other protozoan locomotors, is irreducibly complex and signifies God's hand in creation. This is not the case. There are multiple ideas related to these organelles that are best explained by evolution. Variety, sequence similarity, and exaptation are all mentioned in an article by Mark Pallen and Nicholas Matzke (2006) as reasons favorable towards evolution. First, variety in both form and function is supported by mutations found in evolution. The similarities between cilia and flagella, as well as the vast differences within their distinct categories, do well to illustrate this point. Structural similarity, mainly in proteins and genetic codes, is exhibited in nearly all protozoa. Pallen and Matzke (2006) reference the similar protein sets utilized to form flagella, and cilia are almost always composed of nine pairs of microtubules surrounding two at the center of the shaft (Lynn, 2011, p. 22). Pseudopodia are still relatively unknown to scientists, but it is understood that similar chemicals within the cell cause extension and retraction of pseudopodia in order to elicit motion. Exaptation is a common theme among evolutionists, and demonstrates the idea that structures that arose for a certain function developed other skills and gradually no longer needed the former function to be performed by the structure. Today, pseudopodia are commonly used by many protozoa for ingestion of food, and motility might be a function that will dissolve. Scientists have considered this idea related to flagellar structures, and find it easy to envisage exapted functions and to develop an evolutionary model. It is highly viable that flagella were used for sensory purposes like cilia, and then became primarily utilized for locomotion.

Metabolism: Digestion and Nutrition

Like all other living organisms, protozoa also metabolize food for energy. Metabolism encompasses both synthesis and catalysis: "the conversion of nonliving material into cellular components and the decomposition of organic matter" ("Life.," 2020). Most protozoa are bacterivores, and consume anywhere between ten to several thousand bacteria per hour through a food vacuole (Thorp et al., 2001, p. 65). Food is generally taken in through a cytostome, or cell mouth, with the aid of specialized cilia. Throughout a protozoon's life, this mouth can enlarge or diminish to take in more or less food. In other species, food is ingested via phagocytosis through a pseudopodium. There are multiple astomatic protozoa that "have evolved elaborate holdfast structures in the form of hooks, spines, spicules, and suckers" (Lynn, 2011, p. 287) to ingest food, because they do not have a traditional oral structure for such a function. On the opposite end of the spectrum, species may have multiple cytostomes that lead to distinct vacuoles. After being ingested, food is transported by way of the cytopharynx to the food vacuole for digestion. This vacuole is located at the end of the cytopharynx, and the discoidal vesicle is largely responsible for its formation (Lynn, 2011, pp. 27, 30). During the digestive process, the food vacuole may grow larger or smaller, and may even exit the cell upon release through the contractile vacuole or cytoproct.

Once food is ingested, the rest of the metabolic process occurs within the cell. Food, when it arrives at the food vacuole, is often quickly digested with special chemicals called acidosomes and lysosomes. Acidosomes are vesicles "filled with acid that fuses with the food vacuole to promote digestion" (Lynn, 2011, p. 16). Lysosomes "contain hydrolytic enzymes," (Lynn, 2011, p. 35) which are secreted to degrade proteins and other nutrients in the ingested specimen, in order to catalyze the food (Vandooren et al., 2013). While nutrients or water are being absorbed, the contractile vacuole ejects remains so as to reduce swelling. All in all, digestion in protozoa is largely similar to digestion in higher organisms like animals.

There are numerous ideas related to protozoa metabolism that point towards evolution as an appropriate explanation. All of these ideas revolve around the concepts of adaptation and mutation. Since most protozoa are bacterivores, it is valuable to consider the bacteria being consumed. Numerous bacterial species have adapted to their environments in such a way that they have developed some resistance to hunting by protozoa. Some species have even become digestion-resistant and "formed relatively stable associations" (Gong et al., 2016) with certain species of protozoa. Because bacteria have adapted to survive protozoa predation, the protozoa themselves have had to adapt. Given these different environments, protozoa respond "by dramatic morphological and metabolic changes, including adaptation of their lipid and energy metabolism" (Hellemond & Tielens, 2006). If God created each of these species, protozoa and bacteria alike, would He not create them perfectly for the life they would live? Why would such mutations like digestion resistance and select metabolism occur? As a result, these mutations either indicate that the form was not originally perfect, or God did not specially create each species.

Growth and Reproduction

When metabolism takes place in an organism, growth is inevitable. In the case of protozoa, growth to a certain size leads to reproduction. Protozoa are limited in how large they can grow, as organelles cannot complete certain vital functions when their body is spread out over a larger area. Growth seems to be a simple concept, but it is valuable to establish a definition: an increase in size of all parts, as distinguished from simple addition of material; it results from a higher rate of synthesis than catalysis ("Life.," 2020). Reproduction takes place when the cell grows too large to sustain itself, and splits to form two new cells. Protozoa reproduce via a myriad of asexual processes, all rooted in the idea of mitosis. There is a growth cycle that can be observed in protozoa, divided into rest, or starvation, stages and reproduction stages. It is important to recognize that these stages do not necessarily follow one after the other. The reproduction stage can repeat itself multiple times before entering a starvation stage, or vice versa. Following division, or a starvation stage, the cell will feed and grow, developing a division cyst that eventually separates into two organisms to enter the cycle once more (Lynn, 2011, fig. 13.1). The original cell is called the parent cell, and the resulting products are called daughter cells.

Mitosis is considered by some to be “the most classical form of asexual reproduction” (de Meeûs et al., 2007, p. 7), because from it flows all varieties of fission. The method of fission widely varies among different protozoan species. The three most common forms of budding, or gemmation, in protozoa are endogenous, exogenous, and evaginative. These all involve the formation of a larval form inside a bud that, when mature, separates from the parent cell. These different forms establish the various ways in which the daughter cell might separate.

First, endogemmy, or endogenous budding, occurs when fission takes place “within a brood pouch, with the embryo or larval form completely free of the parental form before emergence through the birth pore” (Lynn, 2011, p. 27). In this type of fission, the bud formed about the larva is contained within the cell itself. Even though it is inside the cell, it is distinct from the parental form. When the larva has matured enough, it leaves the parental form through the birth pore. This is most comparable to reproduction as observed in humans or other mammals. The embryo is connected to the parent and receiving nutrients, but is held in a distinct pouch within the cell body, and is not a part of the parent cell.

Unlike endogemmy, exogemmy is when buds form on the surface of the cell and pinch off upon maturity (Lynn, 2011, p. 29). The closest similarity to exogenous budding in other organisms could be observed in sharks, when they lose their teeth and new teeth move forward to replace them. Imagine the teeth are new, independent organisms that snap off and grow into sharks themselves, to repeat the process. While this is unlikely to take place among sharks in the near future, this is essentially what occurs in certain species of protozoa when they reproduce.

Thirdly, evaginative budding takes place when the larval forms “first replicate on the ‘parental’ surface of the brood pouch” (Lynn, 2011, p. 216) before separating from the parental form. This separating is abrupt, like a cyst that has formed on the body and suddenly bursts due to pressure, which is caused by, in this case, daughter cell maturity. Evaginate means “to turn inside out or to cause an organ or part to protrude” (Maggenti & Maggenti, 2005, p. 354). Instead of forming within the cell body, the womb is distinct from the body, almost as if it has been turned inside out.

Protozoa reproduction is so drastically different from other forms of reproduction, especially those in higher organisms, that it is difficult to liken it to any commonly known process. One of the things that further challenges one’s understanding of protozoan reproduction is the fact that all of these processes take place asexually. Nevertheless, many protozoa, particularly ciliates, engage in conjugation, which is a sexual phenomenon occurring in primarily asexual organisms. Because protozoa have developed such “complex systems to ensure the faithful replication, correction, and transmission of genetic information from one generation to the next” (Jahn & Klobutcher, 2002), conjugation is largely unnecessary. Notwithstanding, conjugation offers numerous benefits, the most significant of which is adaptation due to genetic changes. The purpose of conjugation is to “exchange gametic nuclei” (Lynn, 2011, p. 89), and takes place when protozoa are starving and find an appropriate mate with whom to conjugate. This process enables and requires fission to take place, thus extending the life cycle of the organism and increasing the quality of life in daughter cells.

In order to exchange nuclei, the two protozoa engaging in conjugation must have a macronucleus and a micronucleus. The micronuclei bind together to exchange information, and the macronucleus dies and is replaced by a clone of the information received through the coupling. In conjugating organisms, sexually starved protozoa that have engaged in self-fertilization enter a period of senescence, which essentially means that they begin to age and normal functions start to deteriorate, eventually leading to death. This can limit the "size and life span" (Thorp et al., 2001, p. 60) of additional offspring formed asexually. However, if such an organism finds a suitable mate and engages in conjugation, this can bring them out of senescence and extend their life.

For centuries, scientists have studied sex. When they discovered asexual organisms, they began to analyze the inferences for evolution. Because sex is the most common method for reproduction among living organisms, it is likely that all organisms engaged in sexual relations until mutations led to asexual reproduction among certain species, including select protozoa. In the study of evolution, scientists often reference a cenancestor, the organism from which all modern species evolved. When considering the entire history of life, and all of the mutations that have occurred, scientists have deduced that "the cellular machinery involved in sexual reproduction probably had a single origin around the time of the evolution of the first eukaryotes" (Charlesworth, 2007). This evolutionary cenancestor was likely a sexual being, as God instructed Noah to take with him onto the ark "two of all living creatures, male and female, to keep them alive" (Passion Resources, 2018, v. Genesis 6:19). Moreover, asexual organisms are closely related to sexual species, and demonstrate lower differentiation, which illustrates the probability of sexual reproduction as a precedence and that asexual reproduction will likely increase as the asexual mutations repeat over many generations (Charlesworth, 2007). Today, protozoa do not have differentiated sexual organs, because reproduction is often an asexual, clonal process. At some point during the evolutionary process, this differentiation must have dissolved among lower species like protozoa.

The dilemma of sexual versus asexual reproduction is that sexual reproduction has a twofold cost over fission, because it must create male and female offspring, therefore diminishing efficiency (Charlesworth, 2007; de Meeûs et al., 2007, p. 14). Asexual organisms are objectively superior. This is not to say that God made a mistake in creating the cenancestor as a sexual being, as sex is considered by many theologians to be an illustration of the unity God desires to have with humanity, and it offers many benefits to organisms across the spectrum of creation. Sex enables mutations to occur, as asexual reproduction alone would result in clones with the same limitations as their ancestors. Regardless, sex is also capable of unraveling the mutation affected by the previous generation. Therefore, the ability of protozoa to reproduce asexually and post-conjugation is an excellent design that naturally facilitates further evolution.

Counterargument

There are some who will disregard the above examples and attempt to reason that God created each organism in their present state of existence. They may approach their rebuttal from a variety of different angles, but it is most valuable to understand their responses to the above proofs in favor of evolution, and so to compare apples to apples.

Earlier, it was established that protozoan locomotion, by way of pseudopodia, flagella, or cilia, demonstrates diversity while maintaining sequence similarity and suggests other functions that evolution assigned to different organelles. It is nearly impossible to discuss the flagellum without considering Michael Behe and his outspoken views in favor of creation, especially his proof related to the mechanics of the flagellum. His main declaration is that flagella are irreducibly complex, and that evolutionists have never attempted to account for the flagellar system in composing that map of mutations (Behe, 2006, p. 271). He defends irreducible complexity by providing that a system like the cilium or flagellum can perform different functions aside from locomotion.

Behe's (2006) defense, however, is largely an attack against revered evolutionary biologists including Thomas Cavalier-Smith (pp. 68–69) and Ken Miller (pp. 222–228). Elaborating on the mechanics of cilia, he claims that "on the whole science should have a good grasp on how the cilium evolved." (Behe, 2006, p. 67) Nonetheless, he speculates as well. Moreover, Behe only investigated the most minute biomechanical systems, but barely ever examines the whole organism. Even while preaching that specialized systems indicate creation, Behe (2006) acknowledges the reality of microevolution because he has no effective refutation (pp. 14–15, 202). By accepting microevolution, Behe cannot rationally continue tearing down evolutionists for his own idea of creation. He has established that macroevolution has not yet been proven, and uses this to "suggest that creation is the only plausible alternative for the origin of life" (Eller, 2003). Unfortunately, his focus on the minute detail of cilia and flagellar systems neither effectively disproves evolution nor proves creation. No one, not even Behe, knows the mind of God well enough to directly interpret how the world was set into motion.

Metabolism, combined with digestion and protozoan nutrition, was used previously to demonstrate that adaptations and mutations are continuously occurring due to food chain relationships between protozoa and their predators and prey. Creationists like Behe have no problem accepting that species have evolved in instances such as these. An explanation could be postulated that such mutations could be a result of the Fall of Man (Passion Resources, 2018, Chapter Genesis 3). Many theologians and church fathers have suggested that predator-prey relationships were a result of the fall, which would indicate that protozoa lived at peace with mosquito larvae and bacteria before Adam and Eve sinned. While some may believe this to be an issue given the relationships between these organisms today, mutations have occurred that enable mosquito larvae to prey on protozoa, and protozoa to prey on bacteria. This idea is perfectly reasonable, and allows such individuals to continue believing that God created every organism.

Evolution, when directed by God, has no reason to discard the previous suggestion. Mutations are the basis of evolution, and the creationists have just acknowledged these occurrences. However, the moment that mutations enter the picture, the argument for creation falls apart. Species cannot be concrete if mutations are occurring as organisms encounter the need to adapt to their living environments. Immediately following the fall, Adam and Eve were exiled from Eden with all other living organisms. Upon leaving the Garden, animals spread across the world and mutated in order to conform to their new living environment. Many creationists, like this one who wrote a frantic defense of creation to a journal editor, believe that mutations are "completely random, and for evolution to be successful we would expect to see a logical pattern" (Berry et al., 2007). Suppose that these mutations are entirely random. Those protozoa that exhibit mutations that increase their quality of life in their given environment have survived and are the examples that can be seen through the microscope today. The unfortunate others who struggled to fight predation or to withstand bacterial infection eventually lost and the mutation passed out of existence.

The previous principle is easily demonstrated in the growth and reproduction of protozoa. However, it is important to establish the creationist argument before attempting to tear it down. As illustrated by Genesis 6:19 in a previous example in favor of evolution, protozoa were designed like all other organisms to reproduce. Creation scientists like Behe may attack the lack of conclusive evidence for evolution from sexual to asexual reproduction, and it is their right to do so. It is very reasonable, in their minds, that God created every organism with their exact functions, including asexual reproduction for some and sexual reproduction for others. If this were the argument, then the creationists would win a point in this debate. They could even say that God created protozoa to reproduce asexually, distinct from other organisms, so as to demonstrate his creation. He gave select species the ability to conjugate as an additional sign of his power.

In a typical cycle of protozoan reproduction, conjugation is not necessary. Some may grow old and die without conjugation, but self-fertilization also serves as a way to end or slow senescence (Lynn, 2011, p. 35). Why would God create an organism capable of two functions in order to achieve the same purpose, reproduction? Furthermore, why would he allow an organism to persist and evade death, after prescribing death for all living things? Research has demonstrate that both fission and conjugation offer unique benefits to protozoa, and both affect mutations in specific ways (de Meeûs et al., 2007, p. 14). Because both have obvious benefits – for conjugation, these include DNA repair, new genetic combinations, and better performance; for fission, these include maintaining mutations, designating specific mutations, and efficiency (Charlesworth, 2007; de Meeûs et al., 2007, p. 14) – there are reasons that God may design organisms to have capabilities for both functions. Mainly, protozoa cannot always find a suitable partner for conjugation and proceed to reproduce asexually, or they may be in a period of senescence and find a partner to conjugate with and thus rejuvenate themselves. These indicate why God would design such an organism, or allow such an organism to evolve, and continue to rely heavily on the eukaryote cenancestor for explanation of their dual existence.

Conclusion

The research surrounding protozoa in recent years has been met with results largely pointing towards evolution. Perhaps this is because creationists are content in their argument, and believe that the Bible is sufficient evidence for their claim. Nevertheless, the argument for creation is weak when put to the test against evolution. Scientists have largely accepted evolution, but not out of blind faith. There have been decades of research devoted to proving this theory, which they still hold to be just a theory, even if they believe it holds more weight today. Michael Behe made an admirable step towards scientific inquiry when he examined the mechanics of protozoan locomotors, but did not use his evidence to tear down evolution and build up special creation. Mutations, whenever they began, are acknowledged by all parties and, though initiated randomly, eventually lead to evident change within a species. This change, should mutations continue over many generations, will lead to the origin of a new species, perhaps a new class, and eventually a new phylum or domain.

In conclusion, the study of protozoa indicates that evolution is the most reasonable cosmogony. This was demonstrated here by examples of intrinsic functions for life in protozoa, including irritability, metabolic processes, and growth. To the readers who may be convinced of special creation, please consider the evidence. If any individual remains confident in creation, please conduct a study that will trump all evidence in favor of evolution, and share the results with the world so that others might be able to view scientific studies demonstrating the evidence for creation and make an objective conclusion. To the individuals who have been questioning the origins of the world, or to those blindly believing whatever they have been told, it is important to understand and analyze the way in which the world was designed and formed to establish a personal understanding of the God of the universe, of microscopic protozoa and everyday humankind.

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