TRIANGLE ASSOCIATION for the SCIENCE of CREATION
P.O. Box 12051 • Research Triangle Park, NC 27709-2051 • tasc@tasc-creationscience.org
Website: www.tasc-creationscience.org

TASC

TASC's mission is to rebuild and strengthen the foundation of the Christian faith by increasing awareness of the scientific evidence supporting the literal biblical account of creation and refuting evolution.

April 2021

The Kingdom Fungi

By C. Gerald Van Dyke, PhD

I will begin this article by asking several questions, then present examples of this marvelous Kingdom, and then finish with my conclusions relative to these questions.

1. How did fungi come into existence?
2. What evidence is there from the fossil record?
3. How are they unique when compared with other organisms?
4. How do they contribute to our environment?
5. How do they cause problems in our environment?
6. Do they appear to have been designed or to have evolved from some other organisms as evolutionary models claim happened?

My primary purpose for writing this article is two-fold, first to show the uniqueness of the living organisms called the fungi. In the words of two Italian scientists, Vassili Tyndalo and Augusto Rinaldi quoting from their book *The Complete Book of Mushrooms*, the fungi are "the inexhaustible cleverness of our Creator!" Secondly, I hope to show that the Lord's cleverness reveals that these organisms were designed by Him for his pleasure and for their usefulness to plants, humans, and animals and for benefit to the environment He has provided for us to live in. The conclusion then is that fungi were designed in their present form and probably did not evolve from some other form of life.

Before I expound on the uniqueness of the Kingdom Fungi, I want to discuss some basic biology of all living organisms.

The basic unit of living organisms is the cell; additionally, living organisms reproduce and metabolize. In other words, they are capable of forming a copy of their original form and are able to perform respiration, use oxygen to produce energy, and expel carbon dioxide. Viruses are usually not considered to be living organisms because, even though they can reproduce and make copies of themselves, they are not able to perform respiration. The simplest forms of life are organisms such as bacteria. Most people are probably familiar with bacteria. Bacteria is the plural form of a single bacterium. They are mostly single celled and have a cell membrane but no cell wall. Cells of animals and humans also lack a cell wall. Bacteria are important in breaking apart large chemical compounds in the process we call decay. If it were not for bacteria and fungi decaying chemical materials, we would be inundated with dead matter everywhere. Bacteria are important in our digestive systems, aiding again in breakdown of chemical materials from the food we eat. They have other significant properties that enable them to provide fermentation and other beneficial activities. Bacteria can cause diseases of plants, animals, and humans.

Animals and humans are organisms possessing similarities to each other in form and function but differ from plants and fungi in that they ingest their food and have cells with a membrane, but no cell wall.

Plants are organisms that differ from the others because they make their own food by process of photosynthesis. Light energy converts water and carbon dioxide into carbohydrates within plant cells. Plants include organisms such as algae, mosses, gymnosperms (cone bearing, like pines), and angiosperms (flowering plants). They have cell walls of cellulose and or lignin in some cases.

Fungi (plural/fungus singular) are organisms that produce and excrete enzymes to break down organic or living material and then reabsorb these nutrients. Fungi have many industrial uses: cheese, fermentation, baking, pharmaceuticals, etc. They have beneficial and harmful interaction with plants. They cause diseases of animals, humans, plants, insects, etc. Their cells have a membrane and walls of chitin. Chitin is a long-chained polymer of N-acetylglucosamine, a derivative of glucose. This polysaccharide is a primary component of cell walls in fungi, the exoskeletons of arthropods, such as crustaceans and insects, the radulae of molluscs, the beaks of cephalopods, and the scales of fish.

Many fungi obtain their food by living as saprophytes: organisms that get nutrients, both organic and inorganic, from dead organic material. Other fungi are parasites, obtaining their food by living in or on other living

organisms. A more specialized form of parasite is called an obligate parasite. This is a fungus that cannot lead an independent, nonparasitic existence.

Also, for clarification I will discuss the words mildew and mold. These are not scientific terms but are frequently used to describe growth types of fungi appearing in such places as one's shower, refrigerator, or on plants. These are various kinds of fungi whose spores are ubiquitous in the air; and when they attach to a surface having a source of water, these spores begin growing and produce a growth of fungal cells that often then make more spores that will detach and be transported to another location either by being washed away or by being carried away in the air. There are some specific fungi that cause mildews on plants, i.e., powdery mildews or downy mildews.

Now I will name some of the many significant known aspects of organisms in the Kingdom called Fungi. Penicillin, an antibiotic compound, is derived from a particular fungal species. The discovery of penicillin provided tremendous advances in medicine for its use in killing detrimental bacteria.

Many other chemicals derived from fungi have provided advances in pharmaceuticals used to combat cancers, chemicals used as immunosuppressors, etc. A fungus causing what is known as ergot of rye has chemistry that has medicinal properties as well. Discovery of fungi used in fermentation processes and baking has had historical significance in those industries. The yeast used in these processes can also cause animal and human diseases. Yeasts also have significance in genomic studies, being the first organisms to have all of their genes sequenced.

My undergraduate and graduate studies were concentrated on plants and fungi and more specialized in plant pathology in my graduate degrees. My graduate studies at the University of Illinois and my subsequent years of research at North Carolina State University involved studies of the interrelationships between fungi and plants. I studied several different plant fungal disease interactions and particularly used microscopic technics for looking at the intricate details of those interactions. I used electron microscopy that enables the fine details to be observed where plant and fungal cells juxtapose. In these studies, I observed such fine-tuned relationships unexplained from an evolutionary perspective. For these closely related cellular interactions to occur, more is involved than just accidental occurrences. In the case of obligate parasitic reactions between the fungus and plant host, the fungus has to delicately invade the plant cell and obtain nutrients without disrupting the host cell. If the fungus kills the host cell, the fungus no longer has a source for food. The objective of the obligate parasite is to get nutrition long enough to make its own spores to reproduce itself and survive. I can't prove that these interactions were designed by a Creator, but I know that the usual evolutionary explanation for these interactions doesn't provide an adequate logical conclusion.

Several fungal diseases of plants have had devastating effects on horticultural, lumber, and human activities. An example of these is Dutch elm disease. Most of the American elm trees in the US, which were a major shade tree in this country, have been destroyed by this fungus. Rust fungi have historically ravaged wheat and other grain crops. I have referenced the many unique aspects of rust fungi in another article.[1] The Irish Potato Famine in the mid-1800s caused starvation in Ireland that caused millions of deaths and led to millions of migrants from Ireland. There are far-reaching economic effects of fungi causing food spoilage, especially during storage phases of certain food types. Animal and human diseases have unfortunate consequences. Animal and human diseases such as fungal nail infections, vaginal yeast infection, blastomycosis, cryptococcosis, coccidiomycosis (valley fever, common in the Southwest US), and histoplasmosis (from a fungus that survives in bird dung). Many more examples of undesirable fungal types could be listed. Again, I have no explanation why our Creator would allow such organisms to cause these devastations. I could suppose they are the result of the "fall," a curse on the earth as a result of man's sin. I can imagine that over time mutations have changed the genetic makeup of organisms so that these harmful diseases occur.

Some additional fungal plant interactions I have studied involve mutualistic formations between the roots of plants and certain species of fungi. These relationships are called mycorrhizal. Myco refers to the fungus and rhizal refers to the plant root. Once again, these relationships are unique in that the fungus either develops a feeding structure inside the cells of the plant root or surrounds the root with a protective wrapping. In both forms of interaction, the fungus aids in the uptake of phosphorus for the plant. Phosphorus is important to plants in the production of energy compounds such as adenosine triphosphate (ATP) and other plant components.

The fungal cell interactions that are involved in both pathogenic plant diseases and mycorrhizal mutualism

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[1] Van Dyke G (2011) Designed interactions between fungi, plants, and animals. *TASC Newsletter*, July < https://tasc-creationscience.org/article/designed-interactions-between-fungi-plants-and-animals> Accessed 29 Jan 2021

involve haustoria.[2,3] Figure 1 is a diagrammatic representation of a cross section of a plant leaf being invaded by a fungal spore (S). The top row of cells is epidermal or the outer layer cells of the leaf. The round cells below that layer are cells inside the leaf. The fungal spore produces a germ tube (GT) and then an appressorium (A), which then produces a penetration structure (PE) that enters the interior of the leaf. A haustorial mother cell (HM) prepares the fungus for its invasion of the interior leaf cell through its wall, but not its membrane. The structure formed inside the plant cell is called a haustorium (H). Other fungal cells are shown growing toward other plant cells, preparing to form more haustorial-plant cell interactions.

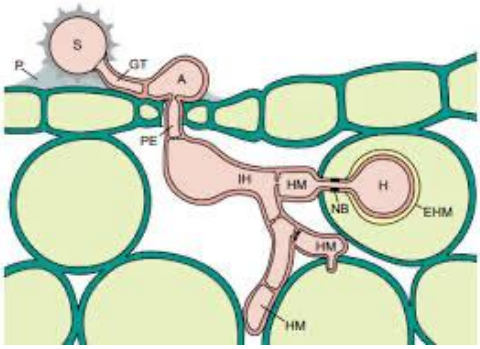

Fig. 1. S - Fungal spore, GT - germ tube, A - appresorium, PE - penetration of epidermis, IH - intercellular hypha, HM - haustorial mother cell, H - haustorium, EHM - extrahaustorial membrane.

According to Szabo and Bushnell, "Fungi that do not kill their hosts utilize specialized feeding structures called haustoria. These structures are formed from a hyphal tip that penetrates into the host cell and forms a union with the plant cell's plasma membrane. Signals between the plant and pathogen travel back and forth through this extrahaustorial membrane, which also serves as the site for the uptake of nutrients. This constant drain of nutrients is a strain on the plant's resources. Plants with such biotrophic infections frequently suffer yield losses and are visibly stunted in their growth."[3]

I have also photographed peculiar fungi attached to ant species.[4] These are members of a group of fungi attached to, but not invading, insects. These fungi grow on the surface of insects, mostly beetles, but are not able to grow apart from the insect. The insect is usually not harmed but provides residence for the fungus to grow and reproduce more of its kind. Figure 2 presents photographs of representative fungal structures from the group called the Laboulbeniales that attach to the surface (exoskeleton) of insects.

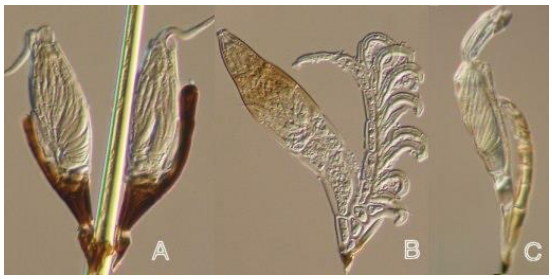

Fig. 2. Panels A, B, and C are three different fungal structures within the Laboulbeniales group. The dark areas at the bottom of each structure are the attachment points to the insect. The elongated football-shaped structures contain fungal spores, and the feathery-like structures are

Now back to the questions posed at the beginning of this article.

1. How did fungi come into existence? As a scientist who believes there is a Creator who spoke all things into existence, I believe God created the fungi as a particular group of organisms that both enhance our environment and also provide benefit to mankind.
2. What evidence is there from the fossil record? Fungi found as individual structures and those associated with fossils of other organisms look in form like the same fungi we know today. They do not give evidence of having evolved from some other kind of organism, nor do they appear to have changed their forms over long periods of time.
3. How are they unique when compared with other organisms? Fungi differ from other living organisms in methods of food gathering, as saprophytes living on dead organic matter or on living organisms. They have different cellular components, and they appear to have been created for specific uses by humans.
4. How do they contribute to our environment? Their interactions with other organisms provide some evidence that they were created as significant parts of a bigger plan for enhancing the benefit of this earth, being created for the benefit of mankind as they impact the environment of plants, plant nutrient interactions, decay processes, and scourges on mankind.
5. How do they cause problems in our environment? Perhaps their detrimental aspects are the result of

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[2] Alexopoulos CJ, Mims CW (1979) *Introductory Mycology, Third Edition*, Wiley & Sons, New York

[3] Szabo LJ, Bushnell WR (2001) Hidden robbers: The role of fungal haustoria in parasitism of plants. *Proc Natl Acad Sci, U S A* 98(14):7654–7655

[4] Nuhn TP, Van Dyke CG (1979) *Laboulbenia formicarum* Thaxter (Ascomycotina: Laboulbeniales) on ants (Hymenoptera: Formicidae) in Raleigh, North Carolina with a new host record. *Proc Entomol Soc Washington* 81(1):101–104

human sin. The Bible says in Genesis that mankind will toil all of their lives. Part of that toil is caused by diseases to plants, to animals, and to humans. Some of the detrimental fungal relationships with plants, animals, and humans have been the result of man's manipulation of the genetics of crop plants and domestic animals. Even humans have deteriorating genetic makeup which could impact our susceptibility to these organisms that then cause diseases. Perhaps mankind has violated God's plans for our world and the way it operates.

6. Do they appear to have been designed or to have evolved from some other organisms as evolutionary models believe happened? I have not observed any evidence to indicate fungi or any other organisms evolved from some other form of life but rather appear to have been created in their own unique ways as part of God's original plan. ☙

COMING EVENTS

TASC Zoom Meeting, Thursday, April 8, 7:00 pm EST

C. Gerald Van Dyke, PhD, child of God, member of TASC Board, Alumni Distinguished Undergraduate Professor Emeritus from North Carolina State University, will present the April meeting. Dr. Van Dyke will present aspects of the unique group of organisms in the Kingdom of Fungi. He will also explain why he doesn't believe these organisms evolved from some other life form; rather they were designed by our Creator for particular benefits to plants, animals, humans, and our environment.

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