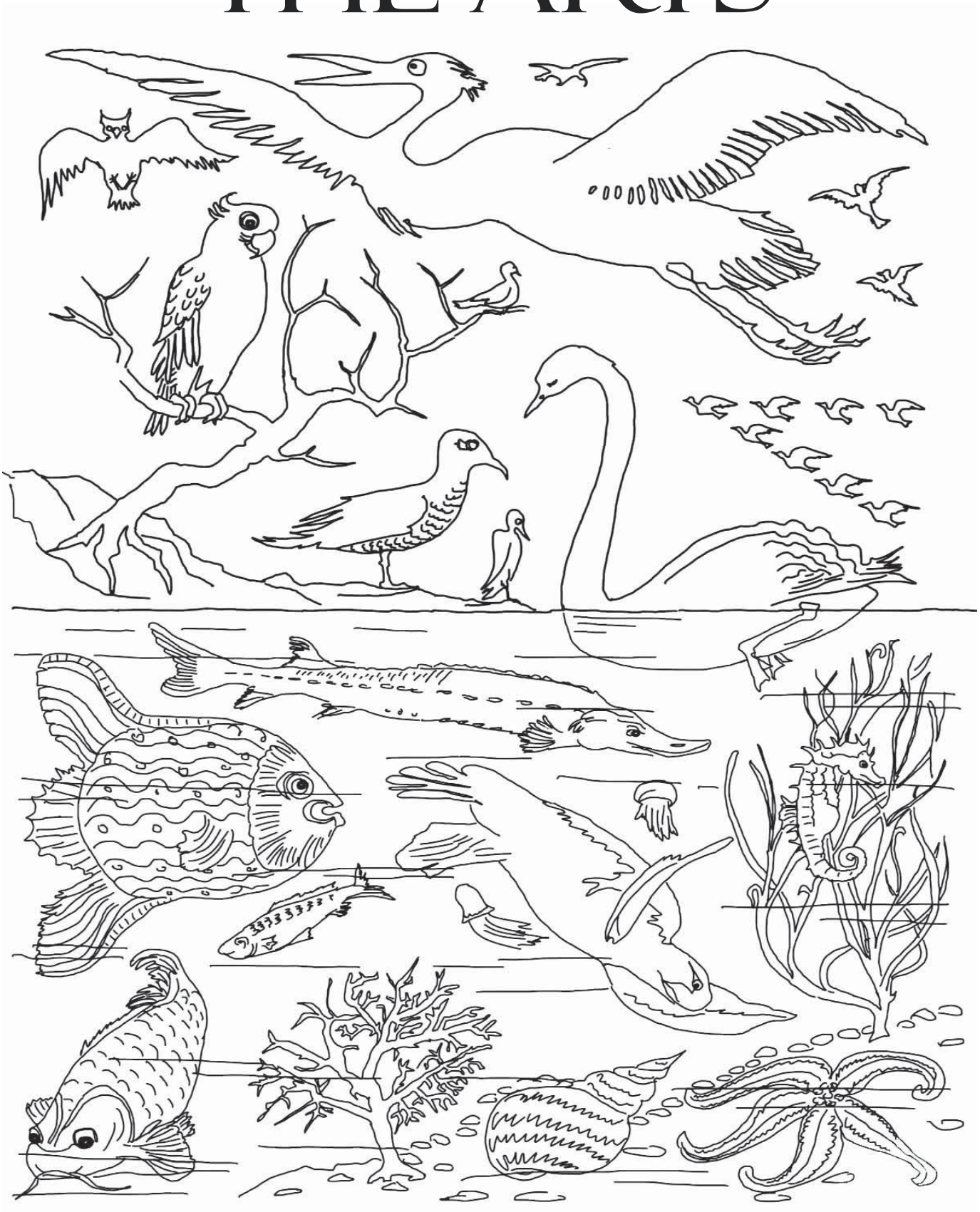
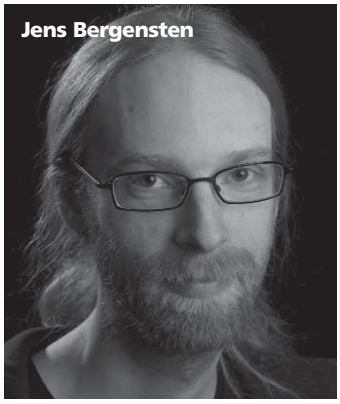
CREATION AND THE ARTS



To Create | BY J. MAILEN KOOTSEY

"Creative" is an adjective widely applied to capable and admired people. Artists create drawings, paintings, and sculptures. Writers create essays and books. Composers and musicians create music. Poets create poetry. Engineers create bridges, roads, and assembly lines. Architects, working with engineers and builders, create buildings. Comedians create laughter and fun. Dancers create beauty in form and motion. Scientists create understanding of natural phenomena. Philosophers create organized worlds of thought. Mathematicians create worlds of symbols and logic. Computer programmers create code. The list could go on and on.


Jens Bergensten

The June issue of the business magazine *Fast Company* featured their list of the 100 most creative people for 2015. Many made the list because of unusual success in business and technology. For example, Jens Bergensten (*right*) was No. 5 on the list as the lead designer of the online game Minecraft that has 100 million players. Number 27 was Jennifer Lewis (*page 53*) who developed a technology that allows 3D printers to print electronic circuits. But not all the list were from the world of business. Number 1 was Charles Arntzen (*page 54*) who developed a treatment for Ebola using the tobacco plant. The comedian Amy Poehler (*far right*) was put at No. 8 for finding multiple new ways to bring comedy to audiences. Position 41 was given to Vian Dakhil, a Member of Parliament in Iraq, for launching a worldwide crusade to save the Yazidi religious minority people who were surrounded and threatened by ISIS. Perhaps the most unusual was No. 65, tattoo artist Vinnie Myers (*page 56*) who helps restore women's personal image by adding realistic nipples to surgically reconstructed breasts.

There is a common theme in all the preceding examples of creativity. Each human creator works within a discipline where there is a variety of building blocks: materials, objects, processes, symbols, or ideas. The creator attempts to find new ways to combine these building blocks to bring about new beauty, new functionality, new ideas, fun, or just plain satisfaction. Painters have a wide range of hues available, ways to arrange the colors on the canvas, and themes. The creative painter aims for an arrangement of patterns and colors that generates a desired response in viewers. Musicians strive for combinations of melodies, harmonies, rhythms, and tones that resonate with and captivate listeners. Engineers choose a task and work to create something that accomplishes the task quickly and efficiently. Chemists put different combinations of atoms together to create new molecules, looking for desired properties.

As a child I used to wonder if there was a limited number of books that could be written, paintings that could be painted, or musical pieces that could be written. Having learned some mathematics, I know now that there is no need to worry that succeeding generations will be left with nothing to create. Let's take an example from digital photography or artistry. Anyone who has bought and used a camera in the past two decades knows that the detail in a digital picture is determined by the number of picture elements or pixels that make up the picture. Each pixel can have a unique color determined by the capabilities of the camera sensor and recording electronics and ultimately by the human eye. Even a modest camera today can record five million pixels for one picture. Estimates of the number of distinct colors recognizable by the human eye range from two million to 100 million. So to be

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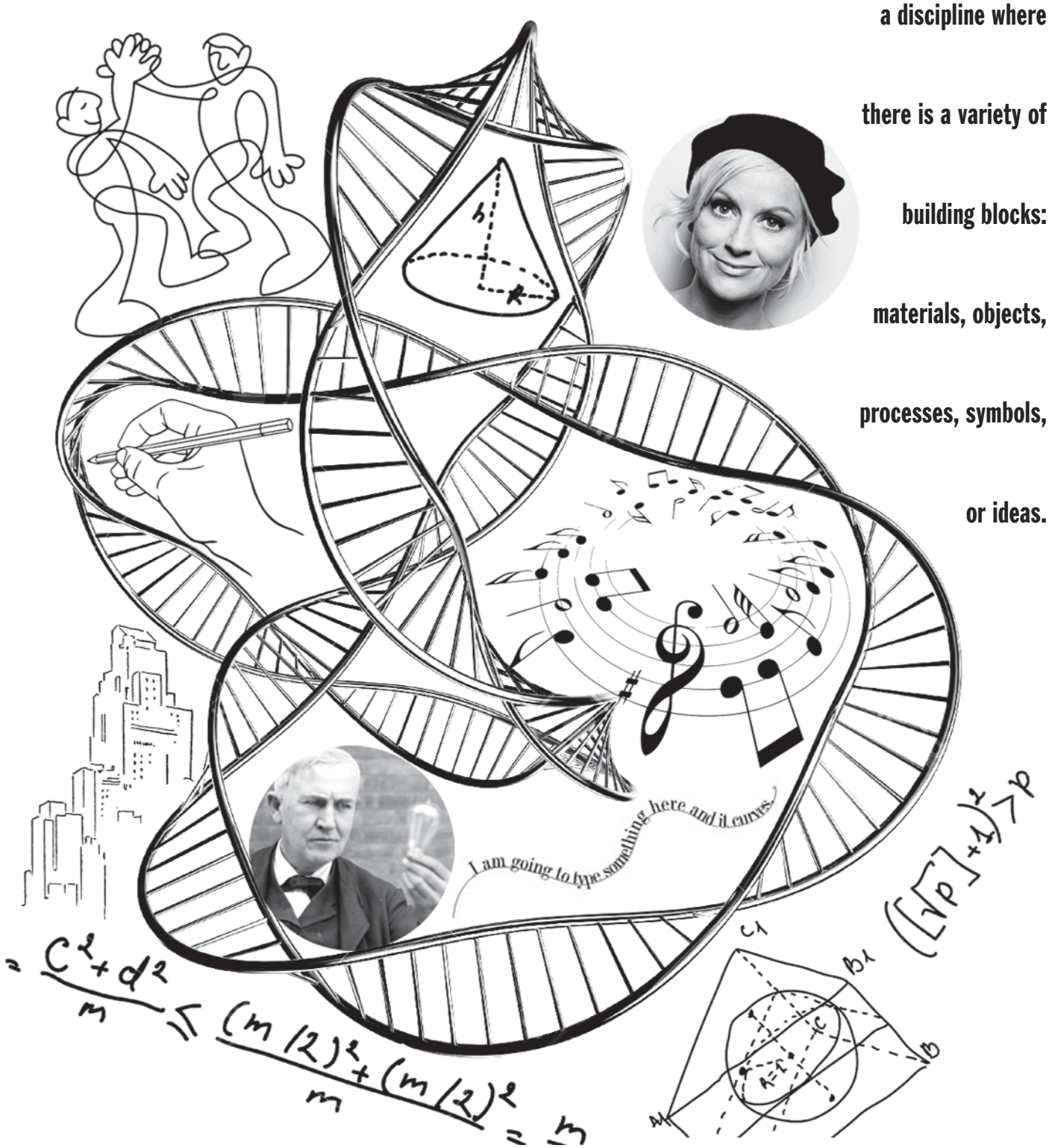

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conservative, how many different pictures could be generated by five million pixels each capable of two million colors? The number of possible pictures is so large that it strains even the capabilities of scientific notation, itself designed to make large numbers palatable: the number is one followed by 13.4 million zeros!! For comparison, the number of atoms in the known universe has been estimated at "only" one followed by sixty-five zeros. Of course, almost all of the virtually infinite number of pictures possible with our theoretical camera are of no interest and would simply be called visual noise. So, it is the job of the photographer or computer artist to create combinations of pixels and colors that attract and hold our attention. Some of the successful combinations come from recording an image from the real world, some come from modified or imaginary images, and others are abstract images that have no origin in real world observation. A similar argument could be made for any field of even modest complexity—visual arts, music, writing, construction of buildings or physical devices, or even scientific experiments; the number of possibilities is so large that humanity will never run out of new things to create.

Why are some people more creative than others? Psychologists and brain scientists have done many studies in search of clues to increased creativity. The field is still in its infancy, but one theme seems clear from the studies to date: creativity increases with diversity and variety on several levels.[1] Individuals who interact with multiple cultures or environments are more creative than individuals who live entirely within one restricted group. Also, teams are more creative when the team includes members of both sexes and individuals with different fields of training and experience. Even social diversity in a team is associated with increased creativity. Debaters and interviewees who are going to face an opposite with known differences are more creative in their interactions because the anticipation causes them to prepare better.

Numerous scientific and technical projects and companies have failed because no one was available (or was listened to) to point out a blind spot. Thomas Edison (*previous page*) is famous as the inventor of sound recording; but, twenty years before Edison's invention, Édouard-Léon Scott de Martinville filed a patent for a machine that recorded sound.[2] He was a printer by trade, but also studied the anatomy of the human ear and the art of steganography (concealing secret messages within non-secret text or pictures). His device funneled sound waves through a horn structure to vibrate a membrane with an attached stylus that wrote waves on a page darkened by lamp black. De Martinville named his device the "phonautograph." Why do we remember Edison and not the phonautograph invented twenty years earlier? Because de Martinville never thought of adding a playback device to his invention. You could only look at the squiggles on the black paper recording, but not listen to them, and the eye is not capable of translating the squiggles back into audible sound. It seems obvious to us now that playback must go with recording, but it was a blind spot for de Martinville and it spoiled his creative act.

The famous physicist Richard Feynman said something that gives us another clue about creating: "What I cannot create, I do not understand." The creator must understand the materials, words, sounds, or ideas that are at hand to form a new creation. That understanding usually comes from long hours of experience, trial, and error. New musicians or young athletes eyeing careers as a soloist or a world class athlete are told that it takes ten thousand hours of practice to achieve their desired goals.

There is a second type of human creator whose methods and appeal are completely different. The magician creates illusions, especially of situations that everyone knows are completely contrary to experience. The

woman lays down in the box and gets sawed in half, only to appear intact later on stage. The fluttering white doves keep coming, one after another, seemingly from no place at all. One moment the cloth covers up a glass of water and a moment later, the cloth is whisked away and the glass and water have vanished. The magician succeeds when she pulls off something appearing obviously unnatural. The audience leaves after being wowed and entertained, but no one has altered their inherent belief that it is dangerous to be sawed in half.


Jennifer Lewis

As stunning as are the human creations in the arts, sciences, businesses, sports, and other areas, thoughts of the ultimate achievements of creativity naturally lead to thoughts about God as Creator. Much energy, writing, and debate has gone into attempts to prove or disprove the existence of God from observations of the world and the universe. Let's lay that particular issue aside for the moment, assume for purposes of argument that there is a Creator God, and ask what we could learn about how that Creator works from observations of human creativity and from the rest of the created world and universe.

Is it appropriate to extend some of the traits and qualities of creative people to describe a Creator God? Humans of all ages do learn something new most readily by analogy and extension of the known, so I am going to use that learning aid here, recognizing its limitations. Let's begin with the creative human who combines materials, objects, processes, symbols, or ideas to produce a new and interesting product. To understand how this analogy can be extended, we have to begin with an idea postulated many centuries ago by Greek philosophers.

Early philosophers, beginning with the Greek Plotinus (third century) and running into the late eighteenth century, saw the universe as a hierarchy they called the "Great Chain of Being."[3] God was at the top of the Chain, followed in descending order by levels of angels, humans, animals, lower creatures, and plants, with inanimate rocks at the bottom—all together covering everything in the universe. This Chain was not based on anything like scientific evidence as presently understood, but was a purely philosophical and logical construction based on ideas from Plato and Aristotle. Plato began by affirming the Idea of the *Good*: "the reign of a rational divine power in all that exists and all that comes to pass in the world." *Good* for Plato meant perfection and self-sufficiency, needing nothing else for its own existence or happiness. Yet, he went on to argue that Self-Sufficing Perfection also included the concept of Self-Transcending Fecundity, so that this divine power must also be the source of a material and variegated universe. Because it was created by a perfect divine being, the creation itself was also assumed to be perfect, although dependent on its Creator and therefore not self-sufficient. The dependent creation idea developed into a classification scheme based on the amount of "soul" in the entity. God was placed at the top, being the ultimate "soul," and the amount of "soul" was seen as decreasing with each lower level until "soul" disappeared entirely in the inanimate rocks. An assumed principle of *continuity* meant that the differences between levels was expected to be very small. It was also assumed that this Chain of Being must be populated with everything that could exist at each level. If anything that was possible was missing, that would be a defect marring the perfection of the Creation. This logical argument was called the principle of *plenitude*. The philosophers thus concluded that because of the principle of plenitude, no new species of ani-

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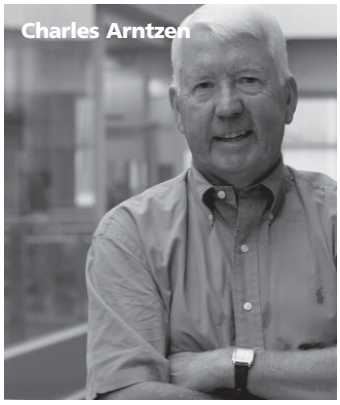
mals or plants could ever appear because any new species would imply a previous lack and imperfection.

Here is a description of the Great Chain of Being, written in a letter by the seventeenth century philosopher Leibnitz:

> *All the different classes of beings which taken together make up the universe are, in the ideas of God who knows distinctly their essential gradations, only so many ordinates of a single curve so closely united that it would be impossible to place others between any two of them, since that would imply disorder and imperfection. Thus men are linked with the animals, these with the plants and these with the fossils, which in turn merge with those bodies which our senses and our imagination represent to us as absolutely inanimate. And, since the law of continuity requires that when the essential attributes of one being approximate those of another all the properties of the one must likewise gradually approximate those of the other, it is necessary that all the orders of natural beings form but a single chain, in which the various classes, like so many rings, are so closely linked one to another that it is impossible for the senses or the imagination to determine precisely the point at which one ends and the next begins—all the species, which, so to say, lie near to or upon the borderlands being equivocal, and endowed with characters which might equally well be assigned to either of the neighboring species.*[4]

As the scientific revolution got under way, the Great Chain of Being was replaced by classification schemes based on observations and data gathering rather than assumptions and logic alone. The current scientific understanding of the universe can also be described as a multi-level hierarchy; not a single chain or "curve," as Leibnitz described it, but a structure with many branches. The contemporary hierarchy is one of size and complexity, extending from invisible particles to the cosmos, and including everything in between. At the bottom level (in present understanding) is the Standard Model of sub-nuclear physics including quarks, leptons (including the electron), and bosons. Level by level, the rest of the universe is seen as built up by synthesis from these elementary particles. Combinations of the sub-nuclear particles make up the more familiar proton and neutron of the nuclear level. Protons combined with neutrons and electrons make atoms. Linking atoms together makes molecules. Different kinds of molecules together form cell organelles, which in turn combine to make up cells. In the biology branch of the hierarchy, cells give rise to organs, then organ systems, and humans and animals. Still higher are families and various cultural groupings on the human side, along with ecologies of animals and plants. Another branch of the hierarchy, starting with atoms, includes all the non-living forms of matter, geology, the earth, the solar system, and the entire cosmos. As the entities from one level are combined to create the next higher level, variations in the number participating and the natures of the relationships that link them determine the qualities that appear in the higher level produced. God is not at the top of the scientific hierarchy, as with the Great Chain of Being. Believers generally place God outside of the universe represented by the scientific hierarchy while non-believers don't even have God in their thinking.


Charles Arntzen

Scientists looking at fossils and counting the observed species on earth long ago rejected the early philosophers' principle of plenitude, that the existing universe must already contain everything possible. The number of living species on earth is estimated to be around ten million (about 1.2 million have been directly observed), but this number is also estimated to be less than one percent of

the total number of species that have lived on earth. In other words, more than 99 percent of the species that have lived on earth are extinct. Species continue to disappear and new species appear[5], so the number is not constant, but varies over time.

For another example, the carbon atom is now recognized as the basis of all life on earth, animal and plant, in combination with other atom types, of course. How many different molecules could be constructed out of carbon? It has been calculated that twenty carbon atoms could be put together in 100 million different molecular structures; but, twenty carbon atoms is very small compared with many biological molecules. One strand of human DNA contains approximately thirty billion carbon atoms; the number of possible molecules that could be made with thirty billion carbon atoms is beyond astronomical! Since the possible number of DNA-sized carbon-based molecules is far, far greater than the number of atoms in the (known) universe, it clearly cannot be true that all possible molecules that could be made out of carbon exist in the universe.

This explosion of possibilities at each new level of complexity is now recognized to exist at every level of the hierarchy of complexity. Like the unimaginable numbers of possible "pictures" that could come from the digital camera sensor, and of molecules created by linking carbon atoms, we find the same essentially limitless possibilities when linking cells to create organs, organs to create organ systems, and so on up the hierarchy. In fact, above the atoms-to-molecules step, we don't even know how to estimate the number of possibilities. For example, no one has even attempted to estimate the number of biological species that are possible.

Now we are finally ready to consider some analogies between human and divine creators. Describing the human creative person as selecting elements (paints, materials, sounds, words, ideas, etc.) and combining them to make something interesting and desirable, we are describing that person as working in a two-level hierarchy—putting components together in specified relationships to create a new more complex whole. This is exactly what occurs at every level of the cosmic hierarchy of size and complexity! If God is characterized as Creator, God is then a creator of a multi-level hierarchy with many levels rather than just two. It would be like our human artist going through all the steps to create paints from sub-nuclear particles (levels below the picture) and in addition (at levels above the picture), designing museums of art, organizing worldwide museums, etc. Just as the human artist creates paintings by selectively choosing colors and patterns that appeal and communicate, so the Divine Creator apparently makes only selective entities at each level from the innumerable possibilities (i.e. no support for the principle of plenitude). Evolutionists say that the results at each level are governed by random events and natural selection, but now there is increasing evidence that there are laws at each level that also influence the combinations that are sustained. There is much yet to be learned about these laws of synthesis[6]. Regardless of the mechanisms involved, though, the overall process is "natural" and characteristic of the universe.

There is another comparison, or rather a contrast, that can be made between human creating and creation in the natural world. Human creating of any object, whether of artistic or engineering type, has always been done in three steps: design, preparation of the components, and finally assembly or linking of the components. The last step could be by hand, by a mechanical process, or more recently by a computer-controlled robot. Creation in the natural world occurs by a very different and much more sophisticated method: self-assembly. A tree, for example, is not constructed by turning the trunk on a giant lathe, drilling holes and inserting the separately-prepared branches, etc., like an

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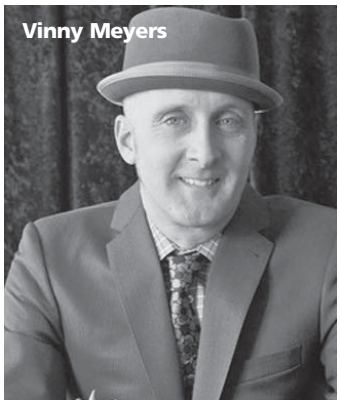
automobile is assembled. Instead, given the right environment, a tiny seed, step by step, "grows" the necessary cells and processes that, over a period of years, produce the tree. Everything we see in the natural universe—from tiny single-cell creatures to galaxy clusters—is produced by a self-assembling, self-organizing process. Creative humans have only recently begun to even think about producing anything by self-organization, with the examples to date consisting of simple changes in shape triggered by changes in temperature or chemical composition. Designing a productive self-organizing process based on the molecular level would require powerful thinking and calculations much greater than today's theories, and the largest supercomputers, can provide.


Vinny Meyers

Early on it was argued that animals grow from single cells because there is a miniature of the adult hidden in the cell. Now we know that the large DNA molecule contains the information necessary to build the adult structure. The "plan" in the DNA is vastly different from architectural plans or diagrams for human buildings or circuits. The latter are essentially "models" of the final product done in a separate medium. Instead, DNA contains instructions for processes that occur when certain external and internal conditions are met—more like a flow chart than a set of final specifications.

Finally, a discussion of creation in the universe would not be complete without a reminder that, in the words of theologian Abraham Joshua Heschel, "Creation is not an act that happened once upon a time, once and for ever. The act of bringing the world into existence is a continuous process.…Time is perpetual innovation, a synonym for perpetual creation."[7] Life on earth ebbs and flows on a human time-scale and, on a longer time-scale, the earth, the solar system, and the whole cosmos also are all constantly changing and new.

Summarizing, we can now say that the universe and everything in it is built from elementary particles by synthesis, complexity increasing level by level and the results determined by relationships in the synthesis. At each new level, only a minute fraction of the possible combinations actually exist, the selection made by laws we do not presently understand. The synthesized units come into existence by self-organizing processes. Finally, creation is not a single event, but rather includes continuous and ongoing processes spanning many scales of time and space.

The Great Chain of Being, originating many centuries ago, assumed the existence of a perfect and all-powerful God and attempted to infer by logic what kind of universe such a God would create. When scientific observation became more common and more sophisticated, many of the assumptions on which the Great Chain was based were shown to be false. In this paper, I have reversed the process, reasoning from a scientific Great Ladder of Complexity to some tentative conclusions about God as Creator.

For many religious believers, God's creative acts are imagined as instantaneous, supernatural (meaning not by any natural law), fiat events. It might seem to these believers that offering explanations for how creation occurred takes away the power and mystery they attribute to God from creation. I suggest that the exact opposite is true: The more that is learned about the complexity and sophistication of the universe, the more admiration and respect for God can grow. I was born with a curiosity about how things work and it led me to become a scientist, but it is not necessary to be a professional to have that curiosity. Today's media are full of how-to-do-it and how-to-fix-it and watch-them-do-it shows.

On television or in a video you can learn to cook, build a fine wood cabinet, or renovate a house. You can watch park rangers, fisherman, recycling crews, and scientific explorers at work. For me, watching any of these activities increases my respect for the individuals involved and for their skills and imagination.

This concept of a fiat Creator God is not unlike the magician variety of creative act described earlier and might well be described by an adaptation of the title of a book by J.B. Phillips: *Your [Creator] God is Too Small.*[8] Supernatural fiat creation resembles the ancient pagan idea of creation by the gods in that it pictures God as acting without law or principle (i.e. on a "whim"), but expecting the creation to obey strict laws. I have tried to suggest by analogy with observations on the natural universe, including human creativity, that God's creation is not lawless or magic, but rather lawful, extremely sophisticated, and made up of real, natural processes that are "supernatural" only in the sense that they are complex, far beyond today's advanced human scientific understanding and engineering capabilities. This interpretation of creation cannot logically be attributed to the Divine by methods of science, but it makes possible a view of a Creator God that is in harmony with the best science, a view that calls for admiration from both the scientifically naïve and the most sophisticated thinkers. ■

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Note: I would like to thank Dr. Lee F. Greer III for providing references regarding ongoing speciation.

References

1. Katherine W. Phillips, "How Diversity Works," *Scientific American* (October, 2014): 43–48; Stephanie C. Hill, "In Pursuit of the Best Ideas," *Scientific American* (October, 2014): 48–49; Victoria Plaut, "Inviting Everyone In," *Scientific American* (October, 2014): 52–57.

2. Steven B. Johnson, *Wired* (October, 2014): 29–31.

3. Arthur O. Lovejoy, *The Great Chain of Being: A Study of the History of an Idea* 1936; New Brunswick, NJ, 2009).

4. For the provenance of this letter of Leibnitz, see reference 1 in chapter V, Lovejoy, *The Great Chain of Being*.

5. There is clear scientific evidence that new species are occurring at the present time and have occurred in historic time. A species is defined as a group of biological organisms that are capable of interbreeding. When a group of individuals is divided and their genetic structures differ enough so they cannot interbreed, they become different species. See http://evolution.berkeley.edu/evolibrary/article/evo_45. Also, see TalkOrigins (http://www.talkorigins.org/faqs/speciation.html) for some classic references from the twentieth century on recent speciation. For a few more recent papers please see documentation of data implicating ongoing speciation: among giant Antarctic amphipods, see H.P Baird, et al., *Molecular Ecology*, 20 (2011): 3439–3454; among fishes of the Gymnocypris species complex on the Tibetan Plateau, see Zhang, R., et al., *PLos ONE*, 8(8) (2013): e71331m; among filter-feeding marine ascidians, see F. Griggio, et al., *Genome Biol. Evol.*, 6:3 (2014):591–605); along with a perspective piece on the likelihood of several strong examples of the somewhat controversial process of ongoing speciation even in the face of homogenizing gene flow without allopathic isolation, see P. Nossil, *Molecular Ecology*, 17:9 (2008): 2103–2106.

6. Stuart Kauffman, *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity* (Oxford, 1995).

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8. J. B. Phillips, *Your God Is Too Small* (New York, 1952 and 1998).

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