Criteria for Fundamental physics principles

J.C. Hodge[1*]
[1]Retired, 477 Mincey Rd., Franklin, NC, 28734

Abstract

The FQXi 2018 essay contest is to consider what makes a description more fundamental than other descriptions. More fundamental descriptions are simpler, more useful, and apply to the entire universe including areas of mathematics, physical sciences, life, and society. For example, if a principle appears simpler for the data in physics but fails in life and society observations, then the principle is false. Human survival requires creativity for advancement and adapting to a changing environment. Creativity's essence appears to be the synthesis of a large diversity of observational types. The amount of unexplained observational data is huge. We need to think about it. We need to form a new, more inclusive paradigm.

1 What "Fundamental" means

Humans have limited ability to comprehend the universe. Our knowledge is neatly divided into separate and independent disciplines. Our survival depends on a generalist approach. Our experience in the macroscopic world serves as a base for what is rational.

Our environment is continually changing. Eventually the Earth itself will die. Can we stay the same? Maintaining status quo is not an option.

Survival for longer a time requires the amount of useful information and models to be expanded. Humans have developed models of how the universe works to serve the required expansion. "More fundamental" means the models humans need to explain the complexity of the entire universe (most

*E-mail: jchodge@frontier.com

general) could be simpler and more useful at the expense of an increased need for synthesis. This is Occam's razor applied to the human understanding of the universe. The synthesis of emergent models replaces the analysis of reductionism. The rules for synthesis must also be more universal.

Conditions prior to a major paradigm shift are (Hodge 2013):
(1) Rapid, small, ad hoc modifications are made to the model as new observations are discovered.
(2) Data are interpreted according to the existing paradigm with marginal results.
(3) Predictions made by the model fail. Therefore, actions have poor or counter productive results.
(4) Some paradigms are so entrenched that they are barely recognized as a postulate such as "Doppler shift" rather than galaxy light redshift.
(5) Great social pressure to reason from accepted postulates exists. This creates a selection bias that is often not recognized. The exceptions are simply deleted from consideration or marginalized. Perhaps this is the reason social outsiders often find the new paradigm.
(6) Observations inconsistent with the popular model are often marginalized or ignored. A very open and tolerant society is required to overcome this bias.
(7) Several "coincidences" have been noticed but there is no understanding about the fundamental similarity.

The necessary paradigm shift in the fundamental models is long overdue.

This essay considers current knowledge concepts in four categories - Mathematics, physical sciences, life survival, and society survival. Universe historical concepts are categorized as emergence. Religious concepts are part of life and society. The next Theory of Everything model is considered to be a unification of principles for cosmology and the quantum world. Few would suggest the same set of principles should include life observations. Still fewer would include society observations. Examples of more fundamental development are suggested in mathematics (Section 2), physical science (Section 3), life survival(Section 4), society survival organization (Section 5), and emergence (Section 6). How the fundamental postulates may be found is in Section 7. The conclusion is in Section 8.

2 Mathematics

Humanity has created mathematical methods of the universe that aid survival. For example, the ancient Egyptians created a book of the length relationships of the sides of a right triangle. The Greeks logically developed the Pythagorean theorem to replace the book. Euclidean geometry allowed better and more complex construction and required the ability to apply the rules of geometry. The Chinese developed the Pythagorean theorem using "Proof by Analogy". The development of coordinate systems allowed the linking of geometry and counting of standard units (algebra) to be combined which vastly expanded synthesis ability. Boolean algebra has allowed construction of faster more complex calculation by computers.

If mathematics is a core of our universe, the success of mathematics helping humanity suggests that a high degree of rationalism is fundamental. Mathematics rejects the idea of duality. The use of statistical mathematics may be used when understanding (the ability to predict observations) is inadequate.

But mathematics and physics have limited ability to describe and predict events. Concepts outside those limits are considered with vague and poorly defined concepts. Consciousness, aims, and intentions are such concepts. Without a scientific definition, the discussion must be vague, subject to many interpretations, and, therefore, useless. Perhaps a new math may describe consciousness and brain functioning. Because of the complexity of the brain, perhaps a branch of combinatorics would be useful.

3 Physical science

Humanity has created physical descriptions of the universe that aid survival. For example, we could remember blue objects fall to earth and red objects fall to earth. The ancient Greek model that states objects seek their natural position could serve to predict the movement of some objects to the center of the universe and others (planets) to remain in the heavens. Each planet with their own physics were needed to explain them "going before" (retrograde motion). But then humans would be required to remember the characteristics of many planetary objects to predict when Easter day occurs. The Ptolemaic model was more accurate than the Copernican model, but was very complex. The Ptolemaic model was more scientifically accepted until

the 19th century when parallax in stars was measured. A simpler model that describes attraction of masses and elliptical orbits is even simpler and predicts that blue objects that fall to Earth on Earth may fall to the moon if near the moon.

The synthesis of mathematics with physical observation has resulted in greater and more accurate predictability. Improved predictability (understanding) allowed greater ability to cause outcomes (wisdom) helpful to humanity. Experimental evidence suggested Maxwell's equations were not invariant with uniform translation motion. Special Relativity restored rationalism to physics. Recently, experimental evidence rejected the wave models of light (Hodge 2014b, 2017). This also rejects dualism, rejects the "ensamble interpretation", and restores coherence to physics. Perhaps the "quantum weirdness" may be removed by using models of the macroscopic world (Hodge 2016a).

Dualism has been rejected by experiment wherever suggested - so far. The current quest is to have one set of principles that can replace the two sets of principles of the big of cosmology and the small of the quantum realm. The requirement is for a set of fundamental principles that serve both the big and the small and that outline a different synthesis. That is, the scales of size need the same set of fundamental principles. The end goal is survival through usefulness.

4 Life

An assembly of chemicals acquires a characteristic of reproduction at some point. This characteristic (Spirit) is more than the sum of the parts. It is life. The necessity of accounting for Spirit is outside reductionism thinking. Hunting and gathering produces enough food for a small population. Natural changes in the environment produce large swings in available food that limits the human population levels to periods of famine. These levels may allow no humans in an area. By observing that some pray animals migrated and by adopting a more encompassing view of this process, humanity developed a method to follow the herds and, thus, assure a more constant supply of food. But the method had to include nurturing the herd rather than overkill the herd and to protect the herd.

Farming uses the diversity and selection processes of the universe to develop new food sources. Grass that became wheat in the mid-east and corn

in the Americas was selected for larger kernels and cultivated to overcome the heavier kernel's tendency to fail to reproduce. Animal husbandry produced even more advantage but required a more encompassing model of natural selection and causation. The understanding of the functioning of DNA results in even higher production. That the technological countries have higher food production per person is no accident.

5 Society

The assemblies of individual families acquire the Spirit of a society. The basic unit of the family required a vast territory in hunter-gatherer societies. An injured man may make arrows and spears and the others could provide food for him. But doing this with a family would not be productive enough to provide for the injured one's life. If one family could unite with others, the diverse skills could complement each other and the greater number of a tribe could make hunting larger game more productive. But what happens if a person kills another of another family? The tribe rules have to be much simpler than blood vengeance and yet leave the tribe united in purpose. Tribe functioning has a limited amount of territory it can control. The wars over territory destroy people and assets, but competition is necessary. Grow or die is nature's rule.

Similarly, a larger group acting for the survival of the group and its productive members has a greater survival potential. Some members may understand some aspects of the universe. Other members may understand other aspects of the universe. For example, some understand semiconductors enough to make transistors. Others understand how to make steel. Together with others with a diversity of skill sets help the society to understand more of the universe and to survive. The challenge becomes to determine the synthesis of the skill sets, to use assets efficiently, and, therefore, to win wars for control of assets with competitors.

Humanity uses the concept of morality to determine rules for short-term individual and government action to yield survival for the group in a competitive and changing environment. Nature presents many different rule sets to serve as examples for the actions and the consequences. Humanity has developed many moral sets that then competed with other moral sets for survival. "Good" in this context is what actions produce survival for the group. "Bad" in this context is what actions produce destruction for the

group. A third class may be "passive bad" which is inaction or consumptions of resources without return. For example, killing a productive member of a group is "bad". Killing a member of a group that is at war with one's group is "good".

Humanity has learned the rules for tribes, chiefdoms, and states. Simplifying the behavior within the group allowed greater numbers and greater survivability. But the applicability of rules among the families (the law) was more complex for the diversity of skill that could be used. The current challenge is to form a set of rules or to create a constitution for a new world order (Diamond 1997, 2012; Hodge 2012).

6 Emergence

Emergent agents and their simple rules of behavior form more complex entities and behaviors (Hodge 2016b). The relation between the agents and the emerged entities is causal. Therefore, because a single universe exists, a single Theory of Everything exists involving causal relations from the very small to the very large and involving the cause of society's success and life' consciousness. Additional concepts such as fractal structures and negative feedback loops from the emergent principal that describe the universe are also helpful.

For example, life's principle of the survival of the fittest could be applied to particles where only the structures of the long-lived particles (photon, electron neutrino, electron, up quark and down quark) are key. The remainders are merely temporary as they form into more stable structures and should not be used to model particles.

Combinations of simpler structures form more complex life. Human embryos go through the stages of evolution. State societies are composed of families, tribes, and chiefdoms. Likewise, electrons and quarks are composed of photons. The analogy of one fractal scale to another is the ancient Chinese "Proof by Analogy".

Two is a very fundamental form of organization. Perhaps there are two fundamental, physical components (hods and plenum) with their Spirit (interaction) and two major structures (sources/spiral galaxies and sinks/elliptical galaxies) of the universe (Hodge 2014a). The hod/plenum model is the only model to predict and describe the Hodge diffraction experiment that rejects all wave model of light (Hodge 2014b, 2017).

Life has found the division of labor/energy/force into two sexes provides survival for more complex life forms. Gregor Mendel may have been thinking of sex division by two when he designed his experiments to look for two (dominant v. recessive) traits with two types such as tall v. short (Bronowski 1973). The sex of a child is not averaged. How the life functions are divided varies among species. The division of nurturing and provide/protect seems to allow humans a more complex structure. Cells divide by two. There are two strands of DNA.

Boolean mathematics has allowed the construction of computers where base-three arithmetic failed. Information models in physics are base-two. Society development is testing the base-three (executive, legislative, judicial) structure. The base-three structure is still in trial but seems to have won the competition with the unitary (leader and aristocratic) societies. It must still survive natural internal collapse tendencies (Glubb 1977; Tainter 1990). Perhaps the next world order can be a base-two structure with a different government/people relationship. For example, the two branches of government could be a modification of the feudal king and clergy branches.

The life and society structures are thermodynamically open systems. Consequently, the universe is not adiabatic and is an open system with sources and sinks (Hodge 2014a).

Conversely, if a principle appears simpler for the data in physics but fails in life and society observations, then the principle is false. The fundamental principle is Nature's rules must be obeyed.

7 How

Start with observations as they are without any model dependent interpretation. For example, consider light from galaxies are red-shifted not Doppler shifted. Microwave radiation is detected in all directions from us not Cosmic Microwave Background radiation. The models for the equipment can be tested on Earth in our scale of size. Search for (think of) a model that explains all the data. Then do a new experiment derived from the new model that rejects many if not all the older models. We are in one universe. There can be only one model of it (an assumption?). The increasing layers of complexity still retain some aspect of the foundation postulates of the universe. That is, the selection aspect of emergence theory selects the rules of survival. What is common to all the layers and surviving entities are the fundamentals

of the universe.

8 Conclusion

More fundamental descriptions are simple and useful and apply to the entire universe including areas of mathematics, physical sciences, life, and society. For example, if a principle appears simpler for the data in physics but fails in life and society observations, then the principle is false. Humanity has created mathematical and physical descriptions of the universe that aid survival. Humanity's advance is measured by the survival of humanity and by the population of humans. This advance is caused by the development of concepts that humans can use to predict and cause favorable outcomes. Humanity may survive longer than the destruction of our Sun by applying simpler concepts that allow understanding (prediction). Human survival requires creativity for advancement and adapting to a changing environment. Creativity's essence appears to be the synthesis of a large diversity of observational types. The synthesis of emergent models replaces the analysis of reductionism. The rules for synthesis are also more universal. The ancient Chinese "Proof by Analogy" is more applicable than "Proof by Logic". The amount of unexplained observational data is huge. We need to think about it.

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