SCIENCE AND RELIGION: INTERPRETING THE DATA

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Introduction

To work in science, it is necessary to develop some basic concepts in order to process the variety of information that is obtained from research. What is thought to be knowledge or information can usually be divided into two separate concepts: data and interpretation. Since data is subject to alternative interpretations, researchers must carefully distinguish between the information that constitutes the collected data and the "information" derived from the data that is presented as evidence in support of an hypothesis. Scientists endeavor to be as objective as possible in this regard but several factors (biases) influence the selection and interpretation of the data.

Data and Interpretation

What is data? What is the difference between data and interpretation? Data consist of measurements, observations or statistics used as a basis for reasoning, discussion or calculation.[1] Data are usually regarded as unalterable facts but may or may not be true. As technology and science progress, "facts" will be discarded, modified or replaced with new data. For example, measurements may form a basis for identification of an object or phenomenon. The actual identifications or calculations are not data; they are interpretations. Much of the controversy that exists in the scientific literature is generated by a rather significant problem: interpretations drawn from limited databases.

The interplay between data and interpretation can be illustrated by the microscopic examination of a very thin slice of rock (commonly referred to as a "thin section"). Polarized light (light that passes through the sample in only two directions) is used to conduct a series of tests on the light properties of the rock. The tests provide a database of light-transmission patterns that can be used by mineralogists to determine the mineral composition of the sample. The identification of the minerals is an interpretion that is based on the light property data. By examining the contact of one mineral with another and by measuring how much of each mineral is present, the rock type can be determined. The geologist who identifies the rock considers the mineral identifications "data" even though the rock identification is actually an interpretation of an interpretation. (The mineralogical "data" was determined originally from the light property data.) The point is that the scope of what constitutes data is actually quite narrow.

Just how valid is an identification? Identifications can be made using comparisons with standards. For example, three thin sections may have the same mineral composition but the mineral contacts may be very different. If the mineral grains are interlocking the rock is an igneous rock. If the minerals are interlocking, elongated and aligned, it is a metamorphic rock, but if the minerals are cemented together, it is a sedimentary rock. If our terms are well defined, identification is fairly easy and relatively reliable.

Since data is limited to what we can measure or directly observe, we need to develop our ability to interpret the data so that we can develop reliable conclusions. An interpretation is an explanation; a means of presenting information in understandable terms.[2] Interpretations are limited by the availability of data and by the bias of the observer. In addition, there are several levels of interpretation. For example, a thin section made of little round, bead-like rocks all cemented together must first be identified as some type of structure. So the first level of interpretation is to identify the little beads as oolites. A second level of interpretation is to explain how they were formed. From observations in modern environments geologists know that oolites are typically found nearshore where they are formed by the agitation of warm, shallow, saline waters. A third level of interpretation would be to apply this knowledge to oolites found in rocks on a mountainside. In other words, geologists take what they know about the modern setting and interpret the ancient setting accordingly. They assume that the oolites on the mountain formed at some time in the past in the same way that oolites form in the ocean or in Great Salt Lake, Utah, USA. That interpretation implies that oolites do not form in any other way; however, this implication may not be true. Another example are the patterns of sandstone that are called cross-bedding. Typically, cross-beds form as currents (wind and water) deposit sand and silt on the lee slope of dunes. By integrating a broad range of data and interpretations (the minerals, rocks, oolites, and cross-bedding) geologists can now develop a fourth level of interpretation: modeling. Models provide scientists with a generalized framework for developing predictions and assessing events that may have occurred in the past.[3]

There is a distinct difference between data and interpretation that must be utilized when evaluating research. Data are actual measurements and observations. Interpretations try to explain what is measured and observed. The validity of an interpretation is based on how well the interpretation accomodates the available data. Interpretations change as the database changes. This is how science progresses.

The Problem of Bias

Scientists are painfully aware that some room for improvement exists since they are subject to error and misconception. They endeavor to maintain an attitude of objectivity with respect to research.[4] This commitment to objectivity has created a sort of aura around scientists and, unfortunately, science has developed a popular image of "infallibility". People often prefer to believe that scientists are objective and deal with absolutes. In addition, some people think that when a scientist draws a conclusion, this indicates that all competing theories have been refuted and other questions have been resolved. A false sense of security has developed from an attitude that scientists have defined immutable scientific laws that explain most observations. Some scientists do little to disspell this image. To complicate matters, the scientific community has adopted the position that any researcher having a religious bias is nonscientific; therefore, by definition, creation-science cannot be science. Such an attitude fails to recognize its own bias.[5]

Technical Bias

There are some serious problems that are inherent in science. Scientists have both "technical" biases to overcome as well as the more subtle, even unconscious factors that influence them.

As scientists grapple with technical problems, they may ask, "How can I acquire the data in a way that will minimize bias?" because the first problem in gathering data is sampling bias. Every scientist has some preconceived ideas about the research that influences the selection of data. Random sampling helps minimize this problem[6] but even then, there are choices made that favor a particular hypothesis. A scientist may also have a blind spot: a failure to recognize data. It is not uncommon for a paleontologist who specializes in fossil snails to collect a wider variety of snails than anyone else on the mountainside. However, that same individual will have fewer clams and corals than other fossil collectors. It is even possible for that individual to find no clams or corals at that location. Why? Because of a built-in collecting bias. The collector was trained to find fossil snails and will mentally shut out all other fossil forms. These other fossils can have a significant impact on the interpretation of that site but the bias of the researcher eliminates that input.

Besides the problems involved with the acquisition of data, the processing of the data can introduce technical bias.[7] A researcher who consistently misidentifies a particular mineral introduces a systematic error or bias into the results. Systematic errors are difficult to overcome and can cause serious problems in the process of theory development.

One example that best illustrates theory development and technical bias is the paleoenvironmental interpretations of the upright stumps in Yellowstone National Park, Wyoming, USA.[8] For many years, there were six pieces of evidence advanced to "prove" that the stumps represented successive fossil forests. Each level of stumps was thought to represent a forest that had grown right in that area, died and was covered by dirt. Later, a new forest had grown over the same region so that ultimately 48 or more forests were stacked one on top of the other in the mountains. Today there are a total of 18 pieces of evidence that indicate that the "forests" are actually stumps that were catastrophically transported to the area during a series of volcanic eruptions. At one time the weight of evidence favored the forest interpretation; now the weight of evidence favors transport. The change in the database can be attributed partly to the use of available technology. Because interpretations are based on assumptions and available data, the available technology naturally contributes to the amount of available data.[9] The use of sonograms to detect upright stumps on the bottom of Spirit Lake for comparison to the Yellowstone stumps and microscopic examination of the fossil wood and ash beds in Yellowstone greatly enhanced the ability of scientists to interpret the depositional environment for the petrified stumps found in the park. In addition, the quality of the data can be a limitation.

For example, root systems broken by transport can be difficult to identify because the petrification process also results in breakage. Therefore, it was important that the cause of breakage be clearly determined. Some isolated specimens with roots broken during transport were identified but that evidence did not provide sufficient support for a transport model. Years of diligent work were required to establish a good quality database for the Yellowstone research.

Interpreting data can be very complex as seen in the Yellowstone deposit. However, the simplest scenario is usually preferred over the more complex in the development of theories. The development of simplified models with computer generated systems produces technical bias because the simplified parameters place limits on the application of the model to real systems.[10]

Certainly, the analysis of the data introduces bias through the qualitative or subjective data that is included. Even the quantitative data is not always as objective as we would like to believe. For example, in the theory of plate tectonics the rate of spreading between two continents is calculated by averaging the rate of movement over a period of years because the margin of error for any given measurement is greater than the distances scientists are trying to measure.[11]

Rigorous testing is required by the scientific method before any theory can be accepted. Today, scientists live in a "publish or perish" environment. Time and monetary constraints limit this crucial testing process. New data is incorporated into current theory because it is easier to get material published if it is generally accepted by the scientific community. In 1986 "Science" magazine issued this statement, "It appears to be customary under the modern peer review system to categorically reject papers for publication that do not support the accepted dogma, irrespective of whether the dogma is fact or supposition." The funding process has an incredible influence on research today.[12] No papers, no money. It's that simple. The rigorous testing proposed by the scientific method is not cost effective; so ideas and concepts are rushed into print and cited in subsequent publications. The monetary pressures increase the technical bias by limiting the experimental process.

Paradigm Bias

In addition to the technical problems there are several unconscious influences at work among scientists.[13] All scientists start with some basic assumptions. Basic assumptions are not provable. A typical example is the assumption that modern environments explain past deposition. These modern analogs are very popular in theory development but there are ancient widespread deposits that are unlike anything being deposited in our modern settings. Scientists assume that processes similar to modern processes created these paleoenvironments. They also assume that the ancient rates of deposition and erosion were similar to the rates at which these processes occur today.[14] Modern analogs are used to imply that slow, gradual depositional and erosional processes were responsible for some very unique deposits, such as the Shinarump Formation. The Shinarump is a deposit that covers 260,000 sq. km. (100,000 sq. mi.) and has a relatively uniform thickness of about 29 m (90 ft).[15] To state that the deposition of this unit was slow when there is evidence for rapid, high energy deposition is ludicrous. To attribute the deposition of such a widespread unit to thousands of streams is equally ridiculous. There is no modern analog for such a widespread, uniform deposit. Based on the lateral distribution, the best analog would have to be a marine system but the Shinarump has been interpreted as a fresh water deposit. Using the present as "the key to the past" introduces bias and such assumptions may introduce a pervasive bias.

Each scientist also has some personal paradigm biases.[16] The influence of an individual's training has enormous impact on that person's approach to science. Many schools pride themselves on the "mind set" of their graduates. Personal religious beliefs also make an impact. A naturalistic evolutionist will never look at a fossil and say, "This animal died in Noah's flood." The thought that the Noachian flood may be responsible for the death of that life-form will never cross that person's mind. Why? Because that individual does not even believe there was a worldwide flood. That's personal bias. In the same way, a creationist does not look at a fossil and say, "Here is evidence for millions of years of evolution." Does that make them poor scientists? No. It shows that all scientists have a worldview governs their interpretations.

Community paradigm biases include the pressure of reputation. Before unmanned probes went into space, the astronomers thought that Mercury's period of rotation took 88 days. Students conducted laboratory exercises to determine Mercury's period of rotation and they all came up with 88 days for decades. Then a rocket was launched and we discovered that Mercury's period of rotation is 59 days.[17] How could this happen? The man who first determined the period of rotation for Mercury was a very well-respected astronomer, a meticulous researcher, and no one believed he could have made such a mistake.[18] His reputation introduced bias into the scientific community.

It is difficult to break with traditional interpretations. Scientists tend to find new things within a framework defined by the scientific community.[19] J. Harlan Bretz working in Eastern Washington and Western Montana, USA, discovered deposits that he thought could only be interpreted as a gigantic flood.[20] He was laughed out of professional meetings. Everyone knew that such large scale structures and erosion took a long time to form. A catastrophic flood was unreasonable. It took four decades of hard work and a lot of courage to prove that he was correct.

The second community bias comes from the band wagon philosophy. Glaciation theory is an example of this pressure. Once criteria were developed to identify glaciation, geologists were finding evidence for glaciation everywhere. Unfortunately, in most places they used only one or two criteria as evidence for glaciation. For example, debris flows are structurally very similar to glacial till. In addition, debris flows facet boulders, polish surfaces and produce striations. All of these features were used in the 1960's as criteria to identify glaciated regions. Since such an interpretation requires multiple lines of evidence in a single locality, some of the work that was done during the glaciation band wagon of the

1960's has been reinterpreted.[21] Today, landforms are considered more reliable criteria for determining glaciated regions but even landforms are subject to interpretation. Interpretations are very complex and scientists must be very careful when developing their conclusions.

Implications for Science and Religion

Several points need to be considered with regard to the interface between science and religion. First, not all data is accurately measured and sometimes it is difficult to differentiate between data and interpretation. (Data is an actual observation, whereas interpretation is an explanation.) Certainly, multiple, alternative interpretations of any database are not only possible but probable. Second, bias is present in any interpretation because all scientific interpretations are subjective. (It is encouraging to know that most creationist scientists openly acknowledge their bias.) Third, people need to understand the nature of science and how scientists work. People get discouraged because scientific interpretations are constantly changing and they don't know what to believe. But that is the nature of science; that is how it advances. Once one truly grasps this aspect of science, one is not as quick to hang theological beliefs on specific data or scientific concepts. Fourth, while science may be useful and provide relevant information, science should not dictate anyone's theology. If people allow science to dictate their theology, then every time scientific interpretations change, their theology must change whether that change is consistent with their personal experiences or not. On the other hand, theology should not dictate anyone's science. Theology can supply legitimate working hypotheses and constraints for science. In fact, Scripture as an information source suggests avenues of investigation that would not be considered by most non-religious persons. Such research should acknowledge any scriptural bias that may be present and all of the data must be fairly evaluated.

Scientists are fairly confident that they know what they are doing. However, science alone cannot assess the complete database because the scientific approach does not consider the possibility of supernatural involvement in nature and in the history of our earth. Most scientists believe there are irreconcilable conflicts between science and Scripture.[22] Francisco Ayala stated, "To claim that the statements of Genesis are scientific truths is to deny all the evidence.[23] The evidence does not prove either a long or short history for life. The evidence available provides very limited information. The data are not the problem in reconciling science and scripture. It is the interpretation of the data that presents conflicts. It has also been said, "Not only is the present the key to the past, but the present is the key to the future."[24] Both the historical account of a worldwide flood and the prophetic account of Christ's second coming proclaim the falsity of that concept.[25] For Christians, the Bible provides a source of information that suggests there is a better way to approach science. From this perspective, harmony between science and Scripture can be recognized. In fact, Christians expect harmony because they recognize God as the Creator of nature and its scientific "laws".

ENDNOTES

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7. Ibid., p. 5-6.

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