

## Chapter 2

# The Origin of Physics

What is physics? One way to answer this question is to describe physics as the study of motion, energy, heat, waves, sound, light, electricity, magnetism, matter, atoms, molecules, and nuclei. This description, aside from sounding like the table of contents of a high school physics textbook, does not really specify the nature of physics. Physics is not just the study of the natural phenomena listed above but it is also a process; a process, which has two distinguishable aspects.

The first of these is simply the acquisition of knowledge of our physical environment. The second, and perhaps more interesting, is the creation of a worldview, which provides a framework for understanding the significance of this information. These two activities are by no means independent of each other. One requires a world-view to acquire new knowledge and vice versa one needs knowledge with which to create a worldview. But how does this process begin? Which comes first, the knowledge or the world-view?

In my opinion, these two processes arise together, each creating the conditions for the other. This is analogous to a present day theory concerning the existence of elementary particles. According to the bootstrap theory, the so-called elementary particles such as protons, neutrons, and mesons are actually not elementary at all but rather they are composites of each other and they bootstrap each other into existence. But, we are getting ahead of our story. We shall wait till later to discuss the bootstrap theory of elementary particles. For now, it is useful to recognize the two aspects of the process of physics described above. Another way to describe the relationship between “the gathering of facts” and “the building of a framework for the facts” is in term of autocatalysis. Autocatalysis occurs when a group of chemicals catalyze each other’s production. Stuart Kauffman has argued that life began as

the autocatalysis of a large set of organic chemicals that were able to reproduce themselves.

The study of physics is generally recognized to be quite old but there are differences of opinion as to how old. Some would argue that physics began in Western Europe during the Renaissance with the work of Copernicus, Galileo, Kepler, and Newton. Others would trace the beginnings back to the early Greeks and credit the Ionian, Thales, with being the world's first physicist. Still others would cite the even older cultures of Mesopotamia, Egypt and China. For me, physics or the study of nature is much older having begun with the first humans.

Humans became scientists for the sake of their own survival. The very first toolmakers were scientists. They discovered that certain objects in their physical environment were useful for performing certain tasks. Having learned this they went on to improve on these found objects first by selecting objects more suitable for the task involved and later actually altering the materials they found to produce manufactured tools. This activity is usually referred to as the creation of technology. But the type of reasoning involved in this process is typical of the scientific method, which begins with observations of nature and moves on to generalizations or hypotheses that are tested. For early humans, the generalizations that were made were not in the form of theoretical laws but rather as useful tools. This is exemplified by the achievement of tools for hunting and gathering, pastoralism and agriculture and the use of herbs for rudimentary medicine. All of these activities required a sophisticated level of scientific reasoning. One might dispute this conclusion by claiming that these achievements were technological and not scientific. We usually refer to the acquisition of basic information as science and its application to practical problems as technology. While this distinction is useful when considering our highly specialized world - its usefulness when applied to early human culture is perhaps not as great. A technological achievement presupposes the scientific achievement upon which it is based. The merging of the technological and scientific achievements of early humans has obscured our appreciation of their scientific capacity.

Primitive science, rooted totally in practical application also differs from modern science and even ancient Greek science in that it is less abstract. Astronomy was perhaps our first abstract scientific accomplishment, even though it was motivated by the needs of farmers who had to determine the best time to plant and harvest their crops. An

example of the sophistication of early astronomy is the megalithic structure of Stonehenge built in approximately 2000 B.C in England, constructed with great effort using heavy rocks weighing up to 50 tons. G.S Hawkins (1988) in his fascinating book *Stonehenge Decoded* concludes that Stonehenge was not merely a temple as originally thought but actually an astronomical observatory capable of predicting accurately lunar eclipses as well as the seasonal equinoxes. One cannot help but be impressed when one realizes that the builders of Stonehenge had determined a 56-year cycle of lunar eclipses.

In his book *The Savage Mind*, Levi-Strauss (1960) reveals another aspect of the scientific sophistication of so-called primitive human cultures whose knowledge of plants rivals that of modern botanists. In fact, Levi-Strauss points out that contemporary botanists discovered a number of errors in their classification scheme based on the work of Linneaus by studying the classification scheme of certain South American Indians.

The examples of early scientific activity so far discussed have centered about the fact gathering aspect of physics. Evidence of interest in the other aspect of physics, namely the creation of a worldview, is documented by the mythology of primitive people. All of the peoples of the world have a section of their mythology devoted to the creation of the universe. This is a manifestation of the universal drive of all cultures to understand the nature of the world they inhabit. A collection of creation myths assembled by Charles Long (2003) in his book *Alpha* illustrates the diversity of explanations provided by primitive cultures to understand the existence of the universe. Amidst this diversity a pattern emerges, however, which enables one to categorize the various creation myths into different classes of explanations. One of the interesting aspects of Long's collection is that within a single class of explanations one finds specific examples from diverse geographical locations around the globe attesting to the universality of human thought. One also finds that within a single cultural milieu more than one type of explanation is employed in their mythology.

Perhaps the oldest group of emergence myths is the one in which the Earth arises from a Mother Earth Goddess as represented by mythology of North American Indians, Islanders of the South Pacific, and the people living on the north eastern frontier of India. In another set of myths the world arises from the sexual union of a father sky god and a mother Earth goddess. Examples of this form are found in the mythology of

ancient Egypt, Greece, India, Babylonia, Polynesia and North America. Other classes of myths include creation by an earth diver, creation from a cosmic egg, creation from chaos, and creation from nothing. In the earth diver myths an animal or god dives into a body of water to retrieve a tiny particle of earth, which then expands to become the world. The cosmic egg myths tell of an egg, usually golden, which appears at the first moment of the universe. The egg breaks open and the events of the universe unfold. In one version the upper part of the eggshell becomes the heavens and the lower part, the Earth. At the beginning of the creation from chaos myths there is disorder or chaos sometimes depicted as water from which a creator creates the universe. Finally, in the creation from nothing myths, which are closely related to the chaos myths, the original starting point of the universe is a void. The best-known example of this group to Western readers, of course, is Genesis, where we read, "In the beginning, God created the heavens and the Earth. The Earth was without form and void and darkness was upon the face of the deep". Other examples of the creation from nothing myth are found among the ancient Greeks, the Australian aborigines, the Zuni Indians of the southwest United States, the Maori of New Zealand, the Mayans of ancient Mexico, and the Hindu thinkers of ancient India.

Having briefly surveyed the various types of creation myths, let us turn to an example of the earliest type and retell the story of Kujum-Chantu, an emergence myth told by the people who live along the northeast frontier of India

At first Kujum-Chantu, the Earth, was like a human being; she had a head, and arms and legs, and an enormous fat belly. The original human beings lived on the surface of her belly. One day it occurred to Kujum-Chantu that if she ever got up and walked about, every-one would fall off and be killed, so she herself died of her own accord. Her head became the snow-covered mountains; the bones of her back turned into smaller hills. Her chest was the valley where the Apa-Tanis live. From her neck came the north country of the Tagins. Her buttocks turned into the Assam plain. For just as the buttocks are full of fat, Assam has fat rich soil. Kujum-Chantu's eyes became the Sun and Moon. From her mouth was born Kujum-Popi, who sent the Sun and Moon to shine in the sky.

The story of Kujum-Chantu attempts a coherent explanation of both the creation of the world and the nature of its physical features and as

such it may legitimately be regarded as a scientific hypothesis. Let us compare it with a modern day hypothesis to explain the existence and the nature of the Earth. According to the modern theory, the Earth, the other planets and the Sun were formed together from the same cosmic dust, which explains the various physical features of the Earth such as its molten iron core, its chemical composition and the nature of its physical features. Although the story of Kujum-Chantu may be considered a hypothesis in the loosest sense of the word, it must be conceded that the modern day theory does a better job of explaining the presently known facts about the Earth and as such is considered a more satisfactory scientific theory. It should also be pointed out, however, that there does not exist a set of truly objective criterion for choosing one hypothesis over another.

From our modern scientific point of view we prefer the second theory because it explains more facts. From the point of view of the member of the culture, which worships Kujum-Chantu their story probably gives them a deeper appreciation of the world. Contrary to popular belief there is no scientific manner for arbitrating between two rival scientific theories. Believe it or not, the choice is made on the basis of which theory is most satisfying on human grounds. Copernicus' Sun centered theory of the solar system was preferred at first by its proponents on aesthetic grounds. We shall return to this question when we discuss T.S. Kuhn's (1972) excellent book, *The Structure of Scientific Revolutions* in Chapter 16.

Treating the story of Kujum-Chantu and the modern theory of the creation of the solar system as equivalent theories for the purposes of illustration is perhaps a bit of an exaggeration on my part. The two rival pictures actually differ in a very crucial manner, which actually disqualifies the story of Kujum-Chantu as a bonafide scientific hypothesis. The difference is that the Kujum-Chantu hypothesis does not make any predictions whereas the modern science hypothesis makes a number of predictions, such as the relative chemical composition of the various planets including the Earth and the Sun. A theory, which makes no prediction, is merely an ad hoc (after the facts) explanation of facts, which cannot be tested. A theory, which has the possibility of being proven wrong because of its predictions, but, nevertheless, continues to explain new facts, inspires confidence in its validity. Although there is not objective criterion for choosing theories, the predictive capabilities of a hypothesis have historically provided the mechanism of choice. The

best argument that can be made to justify this criterion is that it works. Its adoption has led to the incredible wealth of knowledge that we now possess.

Science cannot prove that a hypothesis is correct. It can only verify that the hypothesis explains all observed facts and has passed all experimental tests of its validity. Only mathematics can prove that a proposition is true but that proof has to be based on some axioms that are assumed to be obviously or self-evidently true. Karl Popper (1959 and 1979), was annoyed by those Marxists and Freudians, who always wriggled out of any contradiction between their predictions and observations with some ad hoc explanation. He proposed that for a proposition to be considered a hypothesis of science it had to be falsifiable. Using Popper's criteria as an axiom I (Logan 2003) was able to prove that science cannot prove that a proposition is true. If one proved a proposition was true then it could not be falsified and therefore according to Popper's criteria it could not be considered a scientific proposition. Therefore science cannot prove the truth of one of its propositions. This is the difference between science and mathematics. Science studies the real world and mathematics makes up its own world. Scientists, however, make use of mathematics to study and describe the real world.

The two aspects of physics involving the acquisition of information and the creation of a world picture have one feature in common - they both provide us with a degree of comfort and security. The first aspect contributes to our material security. Knowledge of the physical environment and how it responds to our actions is essential to planning one's affairs. It is from this fact acquiring aspect of physics that technology arises. It is from the second or synthesizing aspect of physics, however, that we derive the psychological comforts that accrue from the possession of a worldview. The possession of a worldview is usually associated with philosophy and religion and not physics. This, unfortunately, is our modern predicament. It should be recalled that for preliterate cultures physics, philosophy and religion were integrated. The same was true for Greek culture. Perhaps the enormous mismanagement of our material resources and our environment, which characterizes our times, could be eliminated if we could once again integrate philosophy, religion and physics.