**History of Scientific Thought**

Before closing this chapter, it may be interesting to go back in history and see how  
science has evolved over time and identify the key scientific minds in this evolution. Although  
instances of scientific progress have been documented over many centuries, the terms  
“science,” “scientists,” and the “scientific method” were coined only in the 19 th century. Prior tothis time, science was viewed as a part of philosophy, and coexisted with other branches of  
philosophy such as logic, metaphysics, ethics, and aesthetics, although the boundaries between  
some of these branches were blurred.

In the earliest days of human inquiry, knowledge was usually recognized in terms of  
theological precepts based on faith. This was challenged by Greek philosophers such as Plato,  
Aristotle, and Socrates during the 3 rd century BC, who suggested that the fundamental nature of  
being and the world can be understood more accurately through a process of systematic logical  
reasoning called **rationalism***.* In particular, Aristotle’s classic work *Metaphysics* (literally  
meaning “beyond physical [existence]”) separated *theology* (the study of Gods) from *ontology*  
(the study of being and existence) and *universal science* (the study of first principles, upon  
which logic is based). Rationalism (not to be confused with “rationality”) views reason as the  
source of knowledge or justification, and suggests that the criterion of truth is not sensory but  
rather intellectual and deductive, often derived from a set of first principles or axioms (such as  
Aristotle’s “law of non-contradiction”).  
The next major shift in scientific thought occurred during the 16 th century, when British  
philosopher Francis Bacon (1561-1626) suggested that knowledge can only be derived from  
observations in the real world. Based on this premise, Bacon emphasized knowledge  
acquisition as an empirical activity (rather than as a reasoning activity), and developed  
**empiricism** as an influential branch of philosophy. Bacon’s works led to the popularization of  
inductive methods of scientific inquiry, the development of the “scientific method” (originally  
called the “Baconian method”), consisting of systematic observation, measurement, and  
experimentation, and may have even sowed the seeds of atheism or the rejection of theological  
precepts as “unobservable.”  
Empiricism continued to clash with rationalism throughout the Middle Ages, as  
philosophers sought the most effective way of gaining valid knowledge. French philosopher  
Rene Descartes sided with the rationalists, while British philosophers John Locke and David  
Hume sided with the empiricists. Other scientists, such as Galileo Galilei and Sir Issac Newton,  
attempted to fuse the two ideas into **natural philosophy** (the philosophy of nature), to focus  
specifically on understanding nature and the physical universe, which is considered to be the  
precursor of the natural sciences. Galileo (1564-1642) was perhaps the first to state that the  
laws of nature are mathematical, and contributed to the field of astronomy through an  
innovative combination of experimentation and mathematics.  
In the 18th century, German philosopher Immanuel Kant sought to resolve the dispute  
between empiricism and rationalism in his book *Critique of Pure Reason*, by arguing that  
experience is purely subjective and processing them using pure reason without first delving  
into the subjective nature of experiences will lead to theoretical illusions. Kant’s ideas led to the  
development of **German idealism**, which inspired later development of interpretive techniques  
such as phenomenology, hermeneutics, and critical social theory.  
At about the same time, French philosopher Auguste Comte (1798–1857), founder of  
the discipline of sociology, attempted to blend rationalism and empiricism in a new doctrine  
called **positivism**. He suggested that theory and observations have circular dependence on  
each other. While theories may be created via reasoning, they are only authentic if they can be  
verified through observations. The emphasis on verification started the separation of modern  
science from philosophy and metaphysics and further development of the “scientific method” as  
the primary means of validating scientific claims. Comte’s ideas were expanded by Emile  
Durkheim in his development of sociological positivism (positivism as a foundation for social  
research) and Ludwig Wittgenstein in logical positivism.  
In the early 20th century, strong accounts of positivism were rejected by interpretive  
sociologists (antipositivists) belonging to the German idealism school of thought. Positivism  
was typically equated with quantitative research methods such as experiments and surveys and  
without any explicit philosophical commitments, while **antipositivism** employed qualitative  
methods such as unstructured interviews and participant observation. Even practitioners of  
positivism, such as American sociologist Paul Lazarsfield who pioneered large-scale survey  
research and statistical techniques for analyzing survey data, acknowledged potential problems  
of observer bias and structural limitations in positivist inquiry. In response, antipositivists  
emphasized that social actions must be studied though interpretive means based upon an  
understanding the meaning and purpose that individuals attach to their personal actions, which  
inspired Georg Simmel’s work on symbolic interactionism, Max Weber’s work on ideal types,  
and Edmund Husserl’s work on phenomenology.  
In the mid-to-late 20th century, both positivist and antipositivist schools of thought were  
subjected to criticisms and modifications. British philosopher Sir Karl Popper suggested that  
human knowledge is based not on unchallengeable, rock solid foundations, but rather on a set  
of tentative conjectures that can never be proven conclusively, but only disproven. Empirical  
evidence is the basis for disproving these conjectures or “theories.” This metatheoretical  
stance, called **postpositivism** (or postempiricism), amends positivism by suggesting that it is  
impossible to verify the truth although it is possible to reject false beliefs, though it retains the  
positivist notion of an objective truth and its emphasis on the scientific method.  
Likewise, antipositivists have also been criticized for trying only to understand society  
but not critiquing and changing society for the better. The roots of this thought lie in *Das*  
*Capital*, written by German philosophers Karl Marx and Friedrich Engels, which critiqued  
capitalistic societies as being social inequitable and inefficient, and recommended resolving this  
inequity through class conflict and proletarian revolutions. Marxism inspired social revolutions  
in countries such as Germany, Italy, Russia, and China, but generally failed to accomplish the  
social equality that it aspired. **Critical research** (also called critical theory) propounded by  
Max Horkheimer and Jurgen Habermas in the 20th century, retains similar ideas of critiquing  
and resolving social inequality, and adds that people can and should consciously act to change  
their social and economic circumstances, although their ability to do so is constrained by  
various forms of social, cultural and political domination. Critical research attempts to uncover  
and critique the restrictive and alienating conditions of the status quo by analyzing the  
oppositions, conflicts and contradictions in contemporary society, and seeks to eliminate the  
causes of alienation and domination (i.e., emancipate the oppressed class). More on these  
different research philosophies and approaches will be covered in future chapters of this book.