was part of a general questioning of the nature of time that took place in the late 19th and early 20th centuries. For anthropologists, Bergson's notion that inner, or subjective, time is experienced as a flow, or *durée* ("duration"), and is only broken up by higher orders of rationalization is a tremendous insight. However, whereas Bergson privileged the individual as the locus of the codification of pure duration, anthropologists tend to see social categories at the root of such rationalization. Ultimately, the Bergsonian and anthropological views are compatible if one accepts that individuals are populated by inherently social concepts.

Whereas Bergson's thinking on time had a more diffuse effect on anthropology, Bergson's work on evolution touches directly on anthropological concerns. In *Creative Evolution,* Bergson returned to his thinking on time and intuition to argue against a notion of mechanistic evolution (as he would characterize Darwin's view). Instead, Bergson posited a creative evolution based on *élan vital* ("creative urge") that took the place of material selection. The creative urge, according to Bergson, accounted for the greater complexity of organisms over time. By placing intuition at the heart of the evolutionary process, Bergson offered a third way for anthropologists to understand evolution, as opposed to Darwin and Spencer. Although today Darwin's view, modified by Niles Eldredge and Stephen J. Gould, is more widely accepted, the effect of Bergson's thinking can be seen in the works of others, such as Pierre Teilhard de Chardin.

Bergson died of bronchitis on January 3, 1941.

— *Michael W. Hesson*

See also **Ecology and Anthropology; Evolution, Models of; Teilhard de Chardin, Pierre**

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Bermúdez de Castro, José María (1952–)

At present, the codirector of the Atapuerca project, José María Bermúdez de Castro Risueño (1952–), is one of the two most outstanding Spanish paleoanthropologists. Research professor at National Museum of Natural Sciences in Madrid, Bermúdez de Castro has been a member of the research team of Atapuerca site since 1982, when Emiliano Aguirre organized a multidisciplinary group to study this hominid site. Since 1991, he has been codirector of the Atapuerca research team that was awarded in 1997 with the Principe of Asturias prize, which is the most important scientific research award in the Hispanic world. Furthermore, Bermúdez de Castro became Member of Real Academia de Medicina y Cirugia de Galicia.

Bermúdez de Castro is very well-known by his research of the human remains from Trinchera Dolina excavations at Atapuerca site. In 1994, several human fossils were discovered: a handful of upper and lower teeth, a large cranial fragment, and a mandible with a molar wisdom tooth in the process of erupting. Furthermore, 36 human fragments were recovered of at least six individuals dated of 780,000 years ago. In 1997, a new human species was defined: *Homo antecessor,* which is considered the species that discovered Europe. These findings allowed him and his colleagues to publish many papers in the most prestigious scientific journals.

In the field of anthropology, Bermúdez de Castro is a specialist in dental morphology, systematic and phylogeny of hominids, growth and development, paleoethology, sexual dimorphism, paleodemography, paleopathology, and sociobiology. His new species *Homo antecessor* is a key "missing link" in the hominids evolution and allowed him to propose a new phylogeny for the last 2 million years. Apart from his main research in Atapuerca, he is also excavating in the Late Pleistocene site of Pinilla del Valle (Madrid).

Bermúdez de Castro's book *El chico de la Gran Dolina: En los origenes de lo humano* (*The Boy of the Great Dolina: In the Origins of the Human*) (2002) is very well-known in Spain. This book constitutes an excellent popularization of his findings in the Atapuerca site, a firsthand chronicle of the *Homo antecessor* discovery, and an exhaustive explanation of

many details of his proposal regarding the origin and evolution of the hominids.

— *Eustoquio Molina*

See also **Arsuaga, J. L.; Atapuerca; Homo Antecessor; Missing Link; Orce**

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Big Bang Theory

Throughout the ages, most people believed that the cosmos had existed for all eternity in an unchanging or static condition, neither expanding nor contracting. One reason individuals held this belief was an absence of scientific data, coupled with the inability to answer questions about the universe through measurement and observation. Another reason was that most individuals' beliefs tended toward parochialism and traditionalism. They preferred to believe in eternal, absolute truths, which supported their beliefs in an eternal, infinite cosmos created by God. With the arrival of the 20th century, both science and technology had developed to the point where scientists were able to formulate and then explore the empirical validity of what is called the "big bang theory." According to this theory of the origin of the universe, at one time all space and time were packed into an incredibly small package or dimension. About 14 billion years ago, this package or dimension increased in size at an unimaginable speed, due to a massive explosion (called "singularity"). The primordial universe that was created consisted primarily of strong radiation, which led to the formation of matter and, eventually, to stars, galaxies, solar systems, planets, and moons. The evolution of the cosmos over billions and billions of years produced the right conditions for life to form on earth, leading to the development of thinking beings such as us. Although no one theory perfectly explains—or can explain—everything about the origin and structure of the universe, the big bang theory is convincing. No other theory comes as close in explaining what scientists think happened in the creation of the cosmos. The big bang theory fits both deductions from mathematical models and conclusions from observations of the cosmos.

The First Cosmologies

The Greek philosophers moved the study of the universe away from a strictly religious approach to a more naturalistic one. Aristotle's ideas influenced philosophers and scientists in the West for centuries. His observations of celestial events convinced him that the earth was spherical rather than flat like a pancake. During lunar eclipses, Aristotle noted that the shadow of the earth on the moon was always round, an impossibility if the earth were flat. A flat planet would have cast an elongated shadow, not a round one (unless he always made his observations when the sun was directly under the earth, an unlikely event). Aristotle made another observation that convinced him of the roundness of earth. He saw the sails of ships coming over the horizon before the rest of the vessel. (On a perfectly flat earth, Aristotle's first view would have been of the entire ship, not just its mast.) Although some of Aristotle's conclusions about the universe were accurate, others were not. For example, he remained steadfast in his conviction that the earth was stationary and the moon, sun, other planets, and stars moved in perfectly circular orbits around the earth.

The impact of both religion and philosophy on cosmology diminished with the growth of the physical sciences. Nicholas Copernicus, a Catholic priest, suggested in 1514 that the sun was stationary and the earth and other planets moved in circular orbits around it. Copernicus's heliocentric view was discounted for nearly a century until two astronomers, the Italian Galileo Galilei and the German Johannes Kepler, reaffirmed Copernicus's deductions. The invention of the telescope (in Holland) in the early