

way that inherited material acts to direct cell divisions constituting development.

Study of development and inheritance centred on the *cell and particularly on the *fertilized egg, recognized by the late 19th century as a single cell. Cytological study revealed the complex processes of somatic cell division, or *mitosis, and cell division producing germ cells, or *meiosis, by 1905. *Chromosomes seemed to provide some sort of preformed information, directing, even if not strictly determining, development. The epigenesis versus preformation issue was, therefore, transformed by the early 20th century into a discussion about qualitative and quantitative cell division and the extent to which cells differentiate independently or dependently, with the help of input from other cells and from the external environment.

In the 1890s, *cell-lineage studies were popular. By the 1920s, various specialized research groups devoted themselves to particular problems in development. For example, Edmund Beecher Wilson (1856–1939) and Theodore Boveri (1862–1915) pursued its cytological aspects, Thomas Hunt Morgan (1866–1945) explored the *genetic contributions to development, and Ross Granville Harrison (1870–1959) and Hans Spemann (1869–1941) attempted to explain how one stage in development gives rise to the next [*induction].

Recently, many geneticists have held that development is actually determined by *genes; thus the egg cell material is developmentally relatively uninteresting. James Watson (*b* 1928) and Francis Crick's (*b* 1916) model of *DNA (1953) strengthened interest in the genetic component of biological development. Yet experiments such as Robert Briggs' (*b* 1911) and Thomas J. King's (*b* 1921) on nuclear transplantation, begun in 1952, have shown that there is a more complex interaction of genetic and egg material than the radical hereditarians might prefer [*cell nucleus; *environmental-heredity controversy]. The *morphological structure, the genetic material, and the internal cellular and the external environment of the developing fertilized egg must all be considered. Although we understand much more than Aristotle about how a seemingly homogeneous egg cell becomes a complex adult, and despite notable contributions by such recent developmental geneticists as Eric Davidson (*b* 1937) and John Gurdon (*b* 1933), the process by which details latent in the germ become translated to adult form remains very little understood.

'Development' also refers to directional change more generally, discussed in *evolution and *evolutionism in man and society.

See also metamorphosis; monsters.

BIBLIOGRAPHY

- G. Allen, *Life Science in the Twentieth Century* (New York, 1975; Cambridge, 1978).
 W. Coleman, *Biology in the Nineteenth Century* (New York, 1971; Cambridge, 1978).
 S. J. Gould, *Ontogeny and Phylogeny* (Cambridge, Mass., 1977).
 J. Oppenheimer, *Essays in the History of Embryology and Biology* (Cambridge, Mass., 1967).
 E. S. Russell, *Form and Function* (London, 1916).
 E. S. Russell, *The Interpretation of Development and Heredity* (Oxford, 1930).

JM

developmental mechanics. *Entwicklungsmechanik*, or developmental mechanics, refers to Wilhelm Roux's (1850–1924) programme of causal analysis of embryological phenomena. Introducing the term in 1895, Roux consciously rejected the word choices of his contemporaries who also sought to analyze *development in physical or *materialistic terms using experimental methods [*reductionism]. He chose 'mechanics' to emphasize the mechanism of development and rejected the term 'developmental physiology', preferred by several of his contemporaries, in order to include study of form in development, or embryological *morphology, as well as study of function, or *physiology [*form and function].

Roux's *Entwicklungsmechanik* outlined an entire programme for research, designating both subject matter (development) and method (experimental analysis along mechanistic lines). Highly influential as the most widely published programme for the causal study of development, it inspired the growing international community of embryologists in the 1890s.

See also induction (biology); organizer.

JM

developmental physiology. See developmental mechanics.

developmental psychology. See cognitive psychology; evolutionism; experimental psychology; Gestalt.

Devil. See witchcraft.

diagnosis. The meaning of this term in any