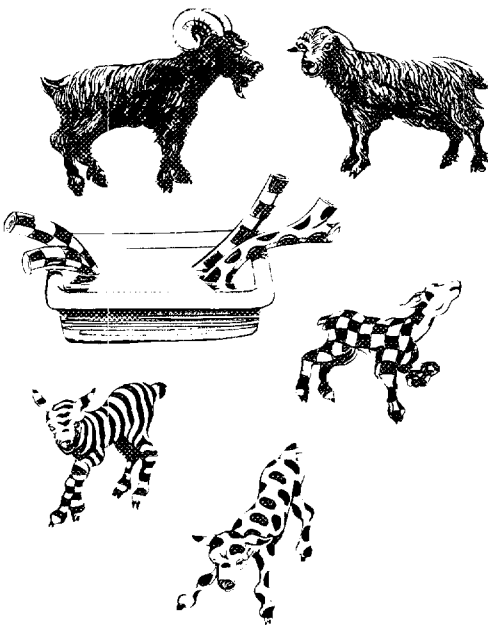


## EARLY IDEAS ABOUT HEREDITY

**A**ncient beliefs about heredity included the idea that inborn characteristics are inherited from parents, as well as the idea that they could be affected by external influences on the parents at conception or during pregnancy. The biblical story of Jacob's wages (Genesis, chapter 30) combines both. Jacob had agreed to tend the flock of his uncle and father-in-law, Laban, if he could take when he left all the unusually colored animals: the sheep with dark wool and the goats with white streaks or speckles. But Laban, a deceitful and greedy man, took his few such animals three days' journey away. The remaining stock he assumed would not produce offspring of the colorations Jacob had named. However, Jacob peeled tree



branches to make them striped and spotted and stood them in the watering troughs when the stronger goats were mating nearby. The kids from those matings, unlike their parents, had the markings that made them his, and they were more vigorous than the offspring of the weaker goats. He herded the sheep so they faced Laban's dark-colored goats; they then bore dark-colored lambs. Today the appearance in offspring

of characteristics different from those of either parent can be attributed to the combined effects of the genetic contributions of each parent (see "Mendelian Genetics").

The ancient Greeks gave considerable attention to human inheritance in their writings. Plato, for example, made cogent statements about human traits being determined by both parents. He emphasized that people are not completely equal in physical and mental characteristics and that each person inherits a nature suited to fulfilling only certain societal functions. Also prominent in the thinking of the early Greeks was the inheritance of acquired characteristics. Aristotle, for example, wrote that

children are born resembling their parents in their whole body and their individual parts. Moreover this resemblance is true not only of inherited but also of acquired characters. For it has happened that the children of parents who bore scars are also scarred in just the same way in just the same place. In Chalcedon, for example, a man who had been branded on the arm had a child who showed the same brand letter, though it was not so distinctly marked and had become blurred.

The idea that external influences play a role in heredity persisted even until the early part of the twentieth century. We now know that the idea contains some truth. For example, ionizing radiation, many chemicals, and infection by some viruses can cause heritable changes, or mutations, but generally those changes are entirely random and cannot be directed toward specific outcomes.

One of the more remarkable theories about human inheritance, pangenesis, was developed in about the fifth century B.C. and espoused by Hippocrates and his followers. According to that theory, semen was formed in every part of the male body and traveled through the blood vessels to the testicles, which were merely repositories. Variations of the theory lasted well into the nineteenth

century A.D. and were even accepted by Charles Darwin. Pangenesis was for some reason dominant in the thinking of the philosophers and theologians of the Middle Ages. Albertus Magnus (1193–1280), his pupil Thomas Aquinas (1225–1274), and the naturalist Roger Bacon (circa 1220–1294) all accepted pangenesis as a fact. One variant of the theory was the idea that both male and female produced semen. According to Paracelsus (1493–1541), semen was an extract of the human body containing all the human organs in an ideal form and was thus a physical link between successive generations.

Also prevalent during the Middle Ages was the concept of entelechy, the Aristotelian idea that the way an individual develops is determined by a vital, inner force. The determining force is provided by the male and transmitted in his semen. The female provides no semen but only, so to speak, raw material. Aristotle compared the roles of male and female in the creation of an offspring with the roles of sculptor and stone in the creation of a sculpture.



Other forms of vitalism continued to be popular even up to the beginning of the twentieth century primarily because people lacked knowledge about the nature of the physical connection between generations of animals and plants.