

# Prelude: Heredity, Sex, and Species: The Greek View

# 1

“Τηλέμαχ', οὐδ' ὅπιδεν κακὸς ἔσσειαι οὐδ' ἀνοήμων·  
εἰ δὴ τοι σοῦ πατρὸς ἐνέστακται μένος ἦϋ,  
οἷος κείνος ἔην τελέσαι ἔργον τε ἔπος τε,  
οὐ τοι ἔπειθ' ἀλήϊ ὁδὸς ἔσσεται οὐδ' ἀτέλεστος.

Homer: *Odyssey*<sup>1</sup>

October has a special significance to the modern scientist, because in this month the Karolinska Institutet in Stockholm announces the year's winners of the Nobel Prizes in three scientific disciplines (as well as in other fields)—medicine and biology, chemistry, and physics. Those scientists who believe that they have made breakthrough discoveries in one of these disciplines await the announcements with hope and trepidation, all others with curiosity. For although there are other awards that recognize the significance of scientific discoveries, none of them carry the prestige that a Nobel Prize does. The accolade is accompanied by great media interest, which then usually lasts until the actual awards ceremony in December. The laureates, however, continue to enjoy a special status among their peers afterward, which often leads to a small avalanche of other awards. They also become adornments to the institutions with which they are affiliated, as well as to their native towns and nations. Outspoken laureates become media gurus, to whom journalists like to turn to for their comments on a variety of political, social, and scientific issues. They remain in the limelight for as long as they are willing to cooperate with the news hunters. For the rest of the laureates, the limelight fades gradually. Nevertheless, they are assured of immortality, even if it may only be restricted to a mentioning of a name followed by a few explanatory lines in a larger encyclopedia. For fame is fickle and the memory of humankind proverbially short—and it is not too difficult to understand why. Nobel Prizes in the three disciplines mentioned have been awarded yearly, with a few exceptions, since their inception at the beginning of the twentieth century. As there are one to three laureates in each discipline each year, in the more than 100 years of award giving, the awardees have grown into a small crowd. Who could remember all their names and accomplishments? Even the practitioners of the three disciplines can at best name fewer laureates than they have fingers on one

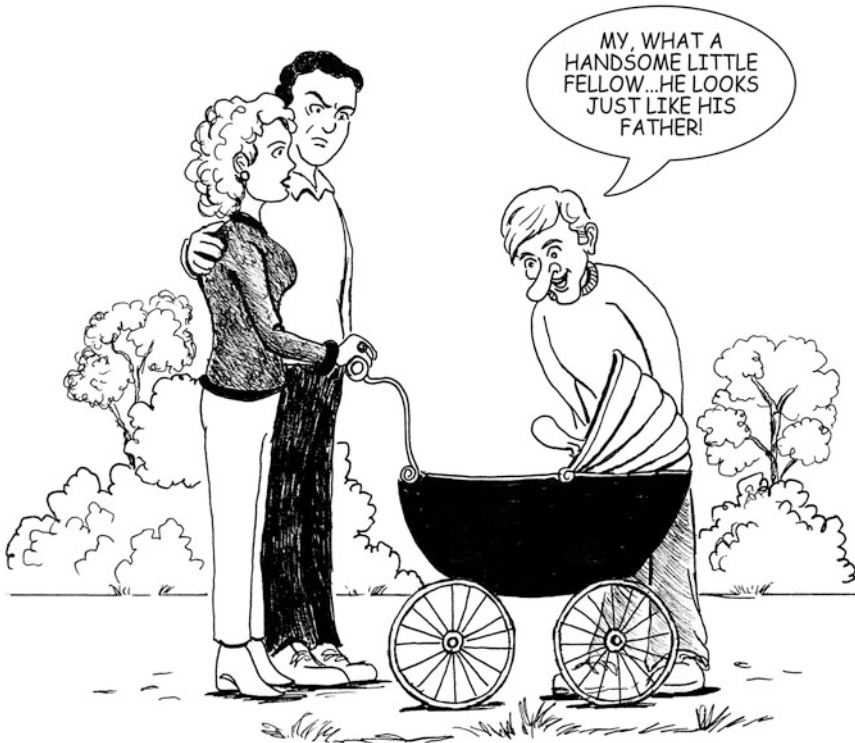
hand. And so all we can expect the active memory of humankind to retain are but a few names that stick out far above the Nobel Prize standard. These are the names of scientists, whose discoveries have changed or have led to a change in the way that humanity views the world. They are scientists like Albert Einstein, Max Planck, and Niels Bohr in the twentieth century; Charles Darwin, Alfred Russel Wallace, and Gregor Johann Mendel in the nineteenth century; Isaac Newton in the eighteenth century; Galileo Galilei in the seventeenth century; and Nicolaus Copernicus in the sixteenth century, when modern science began to emerge.

The inclusion of Mendel in this absolutely top class of scientific giants might surprise some readers, who may be used to thinking of him as a good-natured, pious monk, toiling for years in his small garden, crossing pea plants, until he stumbled upon the observation that their characters segregated at specific ratios. We shall argue in this book that this portrayal of him is nothing more than a myth. We shall argue also against the slander that he cheated, as some biographers have declared, and against the variety of postmodernist claims of Mendel not being a Mendelian (carrying his experiments to disprove Darwin, not carrying any experiments at all, and so on and so forth). We shall show all of these claims to be nonsensical, due to those authors' insufficient knowledge of Mendel's work and of the circumstances under which he labored. We shall show Mendel as being aware of the implications of his discovery, which did nothing less than overturn the more than 2000 year long dominance of the Aristotelian view of heredity and replace it with a modern corpuscular view. But before we turn to Mendel, his life, and his work, we must explain what exactly this old view was and why it prevailed until Mendel's time. What follows will not be easy to read, for it will take us to the heart of Aristotle's philosophy. Hopefully, a reader who perseveres through these difficult parts will come out rewarded with an understanding of the background against which Mendel's achievement must be pitted in order to grasp its real significance. But first a cartoonist's view of the central issue.

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## Heredity Counter Generation

On a sunny Sunday afternoon a young couple strolls through a park with their newborn son in a baby carriage. As they meet a family friend, he leans over the carriage and exclaims: "How cute! He looks just like his father!" (Fig. 1.1). This scene, which must have played itself out time and again in various versions through the ages, epitomizes one of the most profound mysteries of life: the mystery of *generation* or *reproduction*. These two words derive from the Latin verbs *generare* and *producere*, respectively, both of which mean, "to bring forth," "to give rise," "to bring into being," "to beget," "to procreate," or "to give birth." The addition of the prefix *re-* to *producere* emphasizes a second meaning of both words, namely, that besides the act of bringing forth, they also imply a *resemblance* between that which is brought forth and its originator. In the processes of life, the originator is the *parent* and that which originates the *progeny* or *offspring*. The second meaning of generation (reproduction) is most succinctly expressed by the phrase "like begets



**Fig. 1.1** Cuckoo's egg or the incorruptibility of heredity

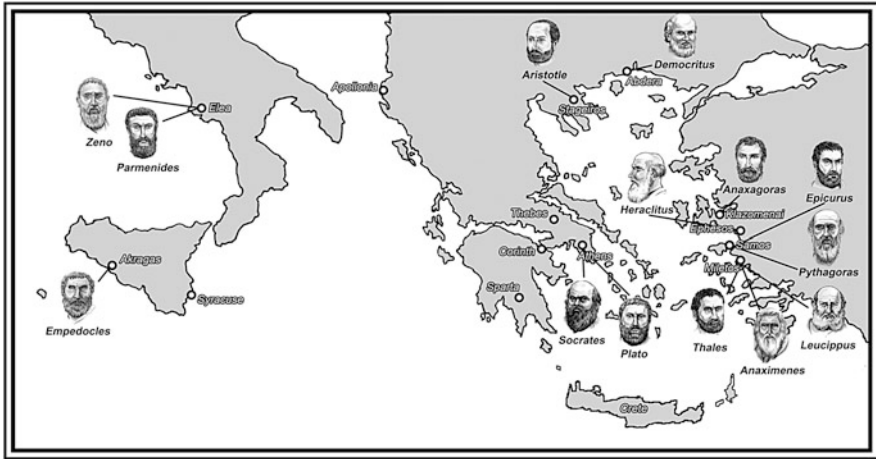
like.” The begetting can be either *sexual* (i.e., involving the union of male and female germ cells) or *asexual* (i.e., not involving such a union). The resemblance between the offspring and its parent has two aspects. The one aspect is that the new individual is normally of the same *kind* (*genus* in Latin) or *species* as the parent (the human species in Fig. 1.1). The second aspect is that within a given species, the offspring resembles the biological parent in a particular feature (the bulbar nose in Fig. 1.1) which is absent in many other individuals of that species. Let us call this transmissible feature *character*, and the phenomenon of transmission *heredity* or *inheritance*. We see immediately how the terms sex, species, and heredity tie neatly together in the concept of generation (reproduction). This concept was developed in ancient Greece in the fifth century Before the Current Era (BCE) by Aristotle and then incorporated into the foundation of Western thought. There it persisted, virtually unchallenged, until the nineteenth century. In that century, however, it underwent a radical reinterpretation, when the speculations on which it rested were subjected to experimental verification. The term “generation” was then largely abandoned in its original meaning (though it eventually acquired other meanings). The three components of generation (sex, species, and heredity) developed into separate sciences: reproduction together with developmental biology, evolutionary biology, and genetics, respectively. The man, who single-handedly accomplished

this transition from generation to genetics, was Gregor Johann Mendel. If we are to appreciate fully the significance and greatness of his accomplishment, we must try to grasp the circumstances under which the generation concept arose and also go into some detail of the concept itself. The aim of this chapter is to do just that. Here we give a brief introduction to the intellectual climate in which the ancient Greek philosophy emerged, followed by an equally brief description of two of its themes which are relevant to the present discussion, and then devote the rest of the chapter to Aristotle's generation concept.

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## The Mutiny of Reason

In the seventh century BCE, what later came to be called Greece was a loose conglomerate of independent, competing, and sometimes warring city-states strewn on the coast along the Mediterranean Sea. Only a common language, shared gods, and similar culture united the city-states. Like other peoples of that time, the Greeks used gods to explain phenomena and events they could not explain otherwise. Thus, they attributed thunderstorms to Zeus sailing the thunderclouds and hurling thunderbolts; earthquakes to Poseidon stomping his feet and thrusting his trident into the ground; winds to Boreas, Zephyr, Notus, and Eurus, each blowing his breath in a different direction; and so on. These explanations were so simple that even the dimmest person could grasp them and so make sense of the world. But for some people, they seemed a bit too simple. Toward the end of the seventh century BCE, a group of savants initiated a movement that expressed dissatisfaction with the traditional view of the world and developed a new view, from which gods were largely expelled. Two words then came to differentiate the traditional and the new views: *mythos* and *logos*. Initially the words had a similar meaning, but as they evolved, they acquired diametrically opposite connotations.<sup>2</sup> The Greek word *mythos* originally meant "speech" or "thought" but gradually came to stand for "a traditional story of ostensibly historical events that serves to unfold part of the world view of a people or explain a practice, belief, or natural phenomenon".<sup>3</sup> The term *logos* might have originally meant "word" or anything connected with the use of words, for example, a "narration." In this sense it was used interchangeably with *mythos*.<sup>2</sup> Later, however, it assumed a new meaning. As the Romans began translating Greek texts into Latin, they rendered *logos* as *ratio*, in certain contexts. This Latin noun was derived from the verb *rerī*, which originally meant "to calculate," and later also processes mentally resembling calculation, such as "to reckon," "to think," and especially to think in a particular way—"to reason." *Logos* thus came to be translated as *ratio*, in the sense of "reason" and *reasoning*. In this special sense, "reason" became nearly synonymous with "cause," and "reasoning" came to mean the kind of thinking in which thoughts followed each other in a cause and effect combination. Other names that came into use for this form of thinking were *rational* and *logical*. These two terms, however, had originally slightly different meanings. As Greek savants established certain rules of thinking and termed the study of these rules *logike* (logic), *logical* became the kind of thinking that adhered to the principles of logic.<sup>3</sup> The Greeks began thinking logically



**Fig. 1.2** *Frogs about a pond*: the geography of ancient Greek philosophy. The quote is from Plato's *Phaedo*; the "frogs" are the ancient Greeks and the "pond" the Mediterranean Sea, which they colonized

already when they were still in the mythological period of their development.<sup>4</sup> They then conceived stories that were myths by their function (explanation combined with an entertainment) and because they moved back and forth between natural and supernatural but had a tendency toward rationality. Poetic and rational thinking mixed freely in these myths, and it was only a question of time for the rational mode of thinking to prevail over the poetic.

The prosperity of the upper classes, the propensity of the Greeks to use rational thinking, and the absence of organized clergy had led to the rise of a breed of self-supporting freethinkers engaged in an intellectual intercourse that resembled an soccer game. The object of the game was to score points not with a ball but with thoughts challenging the opponents to a response. The game was conducted by verbal exchanges at gatherings or symposia,<sup>5</sup> at schools founded by leading savants, and by means of papyrus scrolls on which the authors recorded their thoughts in writing. One of the first such schools arose in the Greek colony of Miletus, an ancient port on the western coast of Asia Minor (Fig. 1.2). The founder of this *Milesian school*, Thales of Miletus (c. 624–c. 543 BCE), and his followers Anaximander of Miletus (c. 610–c. 546 BCE), Anaximenes of Miletus (c. 585–c. 525 BCE), and others focused their inquiries on nature, which the ancient Greeks called *physis*. Their means of inquiry were observation and rational thinking aimed at explaining the world by the operation of natural (material, physical) agents. Because of their focus on *physis*, they came to be known as *physiologoi* (singular *physiologos*), "those who spoke about nature." They were contrasted with *theologoi* (singular *theologos*), "those who spoke of gods," the thinkers who evoked gods (*theoi*) to explain the operation of the world. Together, the *physiologoi* and *theologoi* began to be spoken of as *philosophoi* (singular *philosophos*),<sup>6</sup> "those who loved wisdom." Since the word

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