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The roots of nature

Robert Temple

History of Animals (3 volumes)*; Parts of Animals, Movement of Animals, Progression of Animals (1 volume)†; Generation of Animals (1 volume)‡. By Aristotle. Loeb Classical Library/Harvard University Press: 1937–1991. Each volume \$15.50, £10.50.

Enquiry into Plants, On Odours, On Weather-Signs (2 volumes)§; De Causis Plantarum (3 volumes)||. By Theophrastus. Loeb Classical Library/Harvard University Press: 1916–1990. Each volume \$15.50, £10.50.

Theophrastus of Eresus: Sources for his Life, Writings, Thought and Influence (2 volumes)¶. Edited by William Fortenbaugh et al. Brill: 1992. Pp. 465, 705. £50, \$100, Dfl. 175 (both volumes).

Theophrastus: His Psychological, Doxographical and Scientific Writings.** Edited by William Fortenbaugh and Dimitri Gutas. Transaction: 1992. Pp. 410. \$44.95.

WESTERN science was essentially founded by Aristotle and his pupil and lifetime colleague Theophrastus. But not until now, some two millennia later, have all their surviving zoological and botanical writings become available in decent texts and translation.

Aristotle's writings on zoology were the first great works of scientific observation. Although he considered the explanation of biological phenomena to be the ultimate goal, he recognized the primary importance of gathering data, cataloguing this in his *Historia*. The appearance of the final volume of this work, under the title *History of Animals*, brings to a close the Loeb Classical Library's project of publishing the entire surviving scientific canon of Aristotle in English with facing Greek text, a task that has taken 55 years to complete. And the final volume is the best, containing a spectacularly comprehensive index and the so-called Book X of the *History*, which was tacked on through scribal error centuries ago and has now been identified as Aristotle's separate treatise *On Failure to Generate*. It should be emphasized that the title *History of Animals* is itself a mistranslation — an accurate rendering would be *Information about Animals Obtained by Enquiry*. The work is in fact a magnificent, and often surprising, compilation of just that, relating to no fewer than 560 named species, the structure, physiology and behaviour of many of them described in great detail. Here we learn, for example,

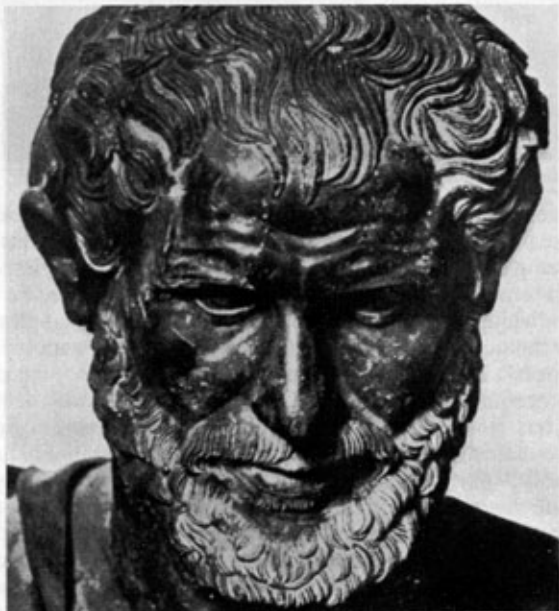
that Aristotle had discovered the 'waggle dance' of bees, anticipating von Frisch by some 2,300 years.

Aristotle was fanatically devoted to personal observation (made easier by the fact that he lived in a wide variety of localities in Greece, Asia Minor and the islands). When he had to rely on the reports of others, he did so with scepticism, often writing "but this has not been verified" or "this has not yet been properly observed". Even his information from exotic locations tended to come only from trusted sources, such as his nephew Callisthenes who accompanied Alexander the Great on his conquests. Alexander, whose tutor Aristotle had been, was a benefactor of Aristotle's studies; royal Macedonian funds subsidized the research institute, called the Lyceum, established by Aristotle at a former gymnasium in Athens in 335 BC. There, Aristotle founded the practice of team research: botany and meteorology were delegated to Theophrastus, music to Aristoxenos, medicine to Diocles, history to Dicearchos, mathematics and astronomy to Eudemos, and so on. The purpose of the 'school' was evidently the construction of an encyclopaedic collection of knowledge about everything in the world, together with explanations if possible.

The unsung heroes of Aristotle's work were his assistants — beekeepers, eel-farmers, hunters, bird-catchers, midwives, fishermen, farmers, camel-drivers, elephant-drivers, horse-trainers, pigeon-keepers, peafowl-breeders, herdsmen, pig-keepers, shepherds, sponge-divers, drug-sellers and ordinary countrymen. He befriended them in complete defiance of social norms. His

zoological works are thus a compendium of what was known by these people in his time. He writes, for example, that "it is a very rare thing to find a female hyaena: a hunter told me that out of eleven hyaenas he caught only one was female". But perhaps most astonishing are his marine observations, which indicate that he hired divers to spy for him; he knew, for instance, that the grey mullet hides its head in the sand of the seabed in the belief that it is thus invisible.

Plenty of evidence of the empirical method exists in Aristotle's work. Indeed, there was originally a companion work to his *History*, entitled *Dissections*. Nearly as long as the *History*, this lost work, to which Aristotle refers constantly, consisted of many annotated dissection diagrams. It seems that Aristotle dissected 200–300 species, from seals to spiders, and although he was coy about admitting it overtly, human corpses. (The *History* itself originally contained simple explanatory diagrams.)



Aristotle: fanatically devoted to personal observation.

Aristotle's longest zoological work, *Close Investigations According to Kind* (*Exētasmēnōn kata Genos*), seemed also to have vanished without trace. But I believe that its scattered contents remain and can be reconstituted. It led directly on from his psychological work *On the Soul* and was intended to 'explain' the phenomena of enquiry marshalled in the *History* in terms of causes, thereby elucidating the essential differences or characteristics of living things. It consisted in sequence of the eight short, scattered treatises now called *Parva Naturalia*, *Parts of Animals*, *Progression of Animals*, *Movement of Animals* and *Generation of Animals*††.

A correct understanding of Aristotle's terminology is the key to his methodo-

* Books I–III and IV–VI translated by A. L. Peck, pp. 239, 414; Books VII–X translated by D. M. Balme, prepared for publication by Allan Gotthelf, pp. 605.

† Translated by A. L. Peck and E. S. Forster, pp. 556.

‡ Translated by A. L. Peck, pp. 608.

§ Translated by A. Hort, pp. 475, 499.

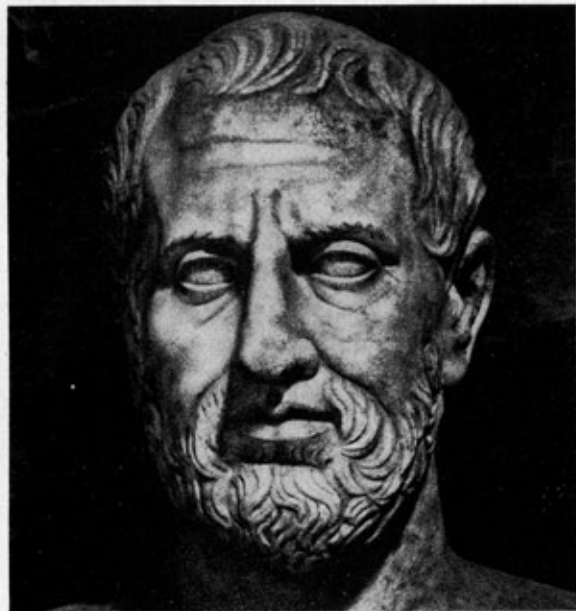
|| Books I & II, Books III & IV and Books V & VI. Translated by B. Einarson and G. K. K. Link, pp. 361, 361, 465.

¶ Contains the complete fragments of Theophrastus in English translation: E. J. Brill, PO Box 900, 2300 PA Leiden, The Netherlands.

** Contains *Meteorology* and *On Fish*; Transaction Publishers, New Brunswick, New Jersey 08903, USA.

†† Aristotle's *On the Soul*, *Parva Naturalia* and *On Breath* are also published in the Loeb Classical Library Series by Harvard University Press (revised 1957, translated by W. S. Hett), pp. 528; \$15.50, £10.50.

logical approach in biology. Modern scholars have now established that the words *genos* and *eidos* should not be translated 'genus' and 'species', and to do so reduces Aristotle's zoology to a confused mass of apparent contradictions. The two terms as used by Aristotle were not classificatory but analytical. Aristotle never had taxonomy as an aim,



Theophrastus: wrote on an immense variety of topics.

even by implication. He used *genos* to mean a category to which a definition of being attaches. An *eidos* is used to locate an entity within a *genos*; the entity's individual essence is then elucidated by a technique called "the listing of differences", by division into parts (a technical procedure derived from Aristotle's previous work on logic). And just in case we had any lingering taxonomic suspicions, Aristotle specifically states that one *genos* can contain others, and furthermore that an *eidos* can become a *genos*. To look backwards at his scheme through our taxonomic spectacles is therefore hopeless — his scientific work took place within a framework of thought quite distinct from that of the modern world.

Aristotle's closest associate was Theophrastus (c.371–c.287 BC), who succeeded him as head of the Lyceum. The two men seem to have been related, and may have been second cousins, as recorded by Ptolemy. Theophrastus shared Aristotle's general philosophical outlook (although he questioned and disagreed with some aspects), his commitment to observation and his range of interests. Most of Theophrastus's writings are now lost, but chief among surviving treatises are two botanical works: his *Historia* and *The Causes of Plants*, now published in the Loeb series as *Enquiry into Plants* and *De Causis Plantarum*, respectively.

Enquiry into Plants is packed full of

fascinating detail. More than 500 varieties of plant are described, and there are attempts at categorization and physiological theorizing (he was clear about the sexuality of plants, for example). The first volume deals with plants that grow of their own accord, whereas the two final volumes deal with "human ingenuity and contrivance" in relation to plants, covering topics such as agriculture, viticulture, and pests and diseases of crops. Part of the introduction of the *Enquiry* seems to have been written by Aristotle, who then handed over the job to Theophrastus.

The causal book, more accurately translated as *Explanations of Plants*, originally contained two more books: Book VII became separated from the main work and for several centuries circulated under the title *On Wine and Olive Oil*, but, apart from five fragments, has now been lost; Book VIII also became separated, although most of it survives as *On Odours*.

But Theophrastus was not just a botanist — he wrote more than 200 treatises on an immense variety of topics, the complete fragments of which are collected and translated, for the first time, in two spectacular volumes just published by Brill. Here we find the separate treatises *On Types of Honey*, *On Flavours* and *On Fruits* and writings on physics, logic, metaphysics, mathematics, theology, zoology, botany, human physiology, ethics, politics, rhetoric, poetics, music and miscellanea. And the publication of Theophrastus's *Meteorology* should also be celebrated. It was thought that this work had been lost, but Hans Daiber found it in a maharajah's library in India in the 1980s, and the Arabic and Syriac texts and English translation now appear in an excellent volume published by Transaction. In *Meteorology*, we are treated to distinctions between different types of earthquakes and atmospheric phenomena (seven types of thunder are described). The volume also contains articles on sensory perception, vision, animal intelligence, the concept of place, the nature of the intellect and the opinions of other philosophers as dealt with by Theophrastus.

Whereas Aristotle died at the age of 63, Theophrastus lived into his 80s, and as many as 2,000 people eventually attended his lectures. In a fragment of a letter written late in his life, Theophrastus confesses that he cannot any longer

delay finishing his work — it is a curious irony that it took him nearly as long to complete his botanical works as it took the Loeb Library to publish them in English.

With these new books, zoologists, botanists, historians of science and philosophers will have an endless feast, and may also begin to understand the extraordinary symbiotic relationship that existed between Aristotle and Theophrastus. □

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