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OCCASIONAL NOTES

Aristotle and Darwin. Parallel Lives

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Introduction

In this bicentenary anniversary of Charles Darwin's birth [1], the debate on creationism and science has sidelined the question of how original and uniquely Darwinian is the concept of evolution.

Erasmus Darwin (1731-1802) Charles' grandfather, Jean-Baptiste Lamarck (1744-1829) and Alfred Russell Wallace (1823-1913) were evolutionary thinkers [2,3]. Wallace's paper *"On the tendency of species to form varieties; and on the perpetuation of varieties and species by natural means of selection"* was read out to the Linnaean society on July 1, 1858 [2], a year before Darwin's publication of *"The Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life"*.

But long before these naturalists developed their theories, others had made important observations on differences and similarities of plant and animal species that paved the way to the concepts that emerged in more recent centuries.

This paper examines the parallel lives of two protagonists - men who lived 2,000 years apart - and their celebrated contributions to the field of natural sciences: Aristotle and Darwin.

Aristotle

Aristotle was born in the year 384 BCE in Stageira, a city in central Macedonia established in the 7th century BCE by colonists from Andros [4,5]. Today Stageira is a small village of 400 inhabitants located 73 kilometres from Thessaloniki, the second largest city in Greece whose University is named after the Greek Philosopher and Naturalist.

His mother Phaesias and his father Nicomachos were descendants from a line of Asclepiads. Nicomachos was personal Physician to King Amyntas II in Pella, the ancient capital of Macedonia. Both parents died whilst Aristotle was young.

In 367 BCE Aristotle, at the age of 17, went to Athens to study at the Academy of Plato.

On Plato's death in 348 BCE Aristotle moved to Assos, a coastal city of Asia minor, south of Troy and then to Lesbos, where he completed most of his biological works. During this period Aristotle married Pythias with whom he had two children a son called Nicomachos and a daughter, Pythias.

In 343 BCE King Philip II of Macedon summoned Aristotle to the Royal court of Pella to instruct Prince Alexander III - later, Alexander the Great.

With Alexander's departure as Commander-in-Chief of the Hellenic Expeditionary force against the Persians, Aristotle returned to Stageira. He married for the second time a native of his city of birth named Herphyllis.

Aristotle returned to Athens in 335 BCE and founded the Lyceum. With the death of Alexander the Great in Babylon in 323 BCE and the political turmoil that swept the Hellenic world including Athens, Aristotle was accused of impiety (ἀσέβεια) and left the city to settle in his mother's estate in Chalkis. He died a year later in 322 BCE from an unspecified gastro-intestinal illness.

In the Lyceum Aristotle established a library and a large research team that engaged in a diverse and unprecedented intellectual effort that encompassed

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most of what is today understood as *the Greek Thought.* According to ancient scholiasts his works include more than 170 titles and at least 445270 lines of prose.

Aristotle studied the inorganic matter, moved to the systematic enquiry of living forms; he interrogated the nature of man, his works and ultimately man's greatest achievement, civilisation. Like his teacher Plato, his early contributions include dialogues, followed by his didactic works.

In this last category belong his zoological and botanical treatises that include the titles:

Περὶ τὰ ζῷα ἱστορίαι, (Historia animalium - On the History of the Animals); Περὶ ζώων μορίων (De partibus animalium - On the parts of the Animals); Περὶ ζώων κινήσεως (De motu animalium - On the motion of Animals); Περὶ ζώων πορείας (De incessu animalium - on the mode of walking of the Animals); Περὶ ζώων γενέσεως (De generatione animalium - On the genesis of the Animals); Περὶ φυτῶν (De plantis - On Plants). Aristotle's studies were enriched with exotic plant and animal species sent to the Lyceum by Alexander the Great from Asia.

Aristotle recognised and described differences and close similarities among the species. He is exercised in his attempt to classify the sea anemone as an animal or a plant; the seal as a land or sea animal; the place of the bat between birds and land creatures. For the apes Aristotle argues that they have characteristics shared by both, quadruped and human. For these intermediate animals with ambivalent biological or anatomical characteristics he uses repeatedly in his book *"The History of the Animals"* the term *ἐπαμφοτερίζειν,* loosely translated as *overlapping on both sides.*

From these works Aristotle emerges as a botanist, zoologist, taxonomist, a biologist in the broadest sense. But he is also a geologist, a meteorologist, political scientist, a philosopher of ethics, a student of language and rhetoric, an analyst of drama and poetry; a historian of ideas and science.

Surprisingly and despite his anthropocentric philosophy he was espoused by the Christian Church and his genius survived the darkness of the middle ages and illuminated the intellectual paths of new thinkers that emerged with the renaissance in Europe.

Darwin

Charles Robert Darwin (1809-1882) was born in Shrewsbury, England. His grandfather Erasmus Darwin (1731-1802), and father Robert Waring (1766-1848) had studied Medicine. Charles' mother Susannah Wedgwood (1765-1817) died when he was 8 years old. He attended Shrewsbury School as a boarder from 1818-1825. He enjoyed throughout his life a prosperous existence that no doubt facilitated his studies of the natural world [1].

In October 1825 Darwin was sent to Edinburgh University to study Medicine. He found the subject unappealing and could not bear the sight of blood. His father proposed the church as a respectable alternative. Whilst in Edinburgh he developed an interest in marine invertebrates which later became a central theme of his studies.

On 15 October 1827 he was admitted to Christ's College, Cambridge, but took up residence in January 1828. In the meantime he refreshed his Greek - essential for his studies - with the help of a private tutor at home.

In his autobiography Darwin admits that he is a poor linguist [6]:

> *During my whole life* - he writes - *I have been singularly incapable of mastering any language...*
>
> *...I could effect with great facility learning forty or fifty lines of Virgil or Homer, whilst I was in morning chapel; but this exercise was utterly useless, for every verse was forgotten in forty-eight hours.*

This passage, as can be seen later, may be important because it implies that Darwin may not have had a full knowledge of Aristotle's zoology or indeed the ability to examine in detail the works of his predecessor.

Darwin was awarded his B.A. in April 1831. Shortly afterwards he was taught the rudiments of field geology by Professor Adam Sedgwick during a tour of north Wales.

In December 1831 Darwin joined as a naturalist the survey ship, HMS *Beagle,* on a round-the-world journey that lasted 5 years. In September 1835 the *Beagle* arrived at the Galapagos Archipelago where Darwin explored the volcanic islands and made important observations on the resident animals on which later he based his theory on natural selection.

In 1839 Darwin married his wealthy and devout cousin Emma Wedgwood (1808-1896) with whom he had 10 children, 3 of whom died at a young age. In 1842 he settled with his family in Down House, in the village of Downe in Kent, where he lived for the remainder of his life.

His major work *On the Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* was first published in London on 24 November 1859 by John Murray to a total of 6 editions during Darwin's time.

Darwin enjoyed poor health for most of his life and became seriously ill in 1863, when he sought ad-

vice from a number of eminent physicians including Dr Henry Bence Jones who was his personal physician for 20 years [7].

His second best known work *The Descent of Man, and Selection in relation to Sex* was published in 1871. Eight years later, following a biographical study of his Grandfather Erasmus, Darwin endured a bitter controversy, accused in 1879 of plagiarism by Samuel Butler [8].

Charles Darwin died on 19th April 1882, aged 73. Following a petition by 20 parliamentarians to the Dean of Westminster he was interred at the Abbey a week later.

Discussion

How familiar was Darwin with Greek thought in general and Aristotle in particular?

His admission in his autobiography, of poor command of Greek, is an indication of his tangential acquaintance with classics.

In the electronic collections of Darwin's works - made available on the internet by Cambridge University - "Aristotle" appears in 46 citations. However, these are not direct references to the original Greek text; rather, citations of Aristotle by other scholars.

In Darwin's Notebook C: on the Transmutation of species (1838.02-1838.07) there is an entry [9]:

> "*Read Aristotle to see whether any my view is ancient?"* (sic)

In 1842, Darwin joined a Committee, appointed *"to consider the rules by which the nomenclature of Zoology may be established on a uniform and permanent basis"*.

Its pamphlet issued on behalf of the British Association for the Advancement of Science, included the following reference to Aristotle [10]:

> The world of science is no longer a monarchy, obedient to the ordinances, however just, of an Aristotle or a Linnaeus. She has now assumed the form of a republic, and although this revolution may have increased the vigour and zeal of her followers, yet it has destroyed much of her former order and regularity of government.

In November 1866 Darwin received a letter from the philologist Clair J Grece of Redhill Surrey.

Grece identifies himself as having a year or two earlier pointed out a passage from Aristotle showing that "Natural Selection" was known to the ancients. Grece's letter containing the reference to Aristotle has not been found, but Darwin added his information to the historical sketch in the 4th Edition of the O*rigin of Species* [11]:

> Aristotle, in his "Physicae Auscultationes" (lib. 2, cap. 8, s. 2), after remarking that rain does not fall in order to make the corn grow, any more than it falls to spoil the farmer's corn when threshed out of doors, applies the same argument to organisation; and adds (as translated by Mr. Clair Grece, who first pointed out the passage to me), *"So what hinders the different parts [of the body] from having this merely accidental relation in nature? As the teeth, for example, grow by necessity, the front ones sharp, adapted for dividing, and the grinders flat, and serviceable for masticating the food; since they were not made for the sake of this, but it was the result of accident. And in like manner as to the other parts in which there appears to exist an adaptation to an end"*.

John William Ogle (1824-1905), a Fellow of Corpus Christi of Oxford and of the Royal College of Physicians of London (he later became Superintendent of Statistics to the Registrar-General) engaged in correspondence with Darwin; some 39 letters had been exchanged between the two men.

In his second letter, Ogle brings to the attention of Darwin the fact that the concept of pangenesis - on which Darwin had developed a provisional hypothesis [12] - was known to Hippocrates.

Darwin's response to Ogle:

> *C. Darwin to W. Ogle*
>
> Down, March 6, 1868
>
> Dear Sir,–I thank you most sincerely for your letter, which is very interesting to me. I wish I had known of these views of Hippocrates before I had published, for they seem almost identical with mine–merely a change of terms–and an application of them to classes of facts necessarily unknown to the old philosopher. The whole case is a good illustration of how rarely anything is new.
>
> ... Hippocrates has taken the wind out of my sails, but I care very little about being forestalled. I advance the views merely as a provisional hypothesis, but with the secret expectation that sooner or later some such view will have to be admitted.
>
> ... I do not expect the reviewers will be so learned as you: otherwise, no doubt, I shall be accused of wilfully stealing Pangenesis from Hippocrates,–for this is the spirit some reviewers delight to show.

Later in 1875 in the revised second edition of his book *The variation of animals and plants under domestication,* discussing his provisional hypothesis of pangenesis, Darwin quotes Ogle in this citation:

"More than 2,000 years ago Aristotle combated a view of this kind, which, as I hear from Dr. W. Ogle, was held by Hippocrates and others"..

The original theory of pangenesis espoused the preformationist concept of the offspring emerging preformed in a miniature form of its ultimate development [13].

Ogle would have cited passages from the original Hippocratic text *ΠΕΡΙ ΓΟΝΗΣ* (On semen) and *ΠΕΡΙ ΦΥΣΙΟΣ ΠΑΙΔΙΟΥ* (On the Nature of the Child) [14]:

Aristotle opposed pangenesis and espoused epigenesis; the theory that an individual is developed by successive differentiation of an unstructured zygote rather than simple enlargement of a preformed entity [13,15].

Aristotle appreciates that the inheritance of a physical characteristic may skip a generation and gives the example of black mark (a *naevus, possibly melanoma?* my own interpretation) that was present in a grandfather, disappeared in the father and reappeared in the grandson:

> Ἤδη δ' ἀπέδωκε τῶν τοιούτων τι καὶ διὰ τριῶν, οἷον ἔχοντός τινος στίγμα ἐν τῷ βραχίονι ὁ μὲν υἱὸς οὐκ ἐγένετο ὁ δ' υἱιδοῦς ἔχων ἐν τῷ αὐτῷ τόπῳ συγκεχυμένον μέλαν [5].

In 1882 William Ogle presented Darwin with his translation of Aristotle's treatise *"On the Parts of Animals"* [16].

In his introductory comments to his translation, Ogle shares Darwin's views on the prohibition religious doctrine imposes on intellectual enquiry. He recruits into this argument Galen, the celebrated Greek physician of the 2nd century CE, and his discussion on the prevailing views on cosmogony at his time [16].

Here follows Ogle's elegant translation of Galen:

> Moses, teaches us that the Creator is lord over the necessary properties of matter, and that he can suspend or modify them at his will. He tells us that the Creator can make an animal of any matter he may please, a man from a stone, an ox from dust. This we deny. The laws of matter are antecedent to the Creator, and obligatory upon him. He can only work in harmony with them. He can choose the best which they allow, but not the best absolutely.

Galen's original text from his treatise *ΓΑΛΗΝΟΥ ΠΕΡΙ ΧΡΕΙΑΣ ΤΩΝ ΜΟΡΙΩΝ ΛΟΓΟΣ Λ,* is given below [17]:

> Οὐδὲ γὰρ, εἰ τὴν πέτραν ἐξαίφνης ἐθελήσειεν ἄνθρωπον ποιῆσαι, δυνατόν αὐτῷ. Καὶ τοῦτ' ἔστι, καθ' ὃ τῆς Μωσέως δόξης ἢ θ' ἡμετέρα καὶ Πλάτωνος καὶ ἡ τῶν ἄλλων τῶν παρ' Ἕλλησιν ὀρθῶς μεταχειρισαμένων τοὺς περί φύσεως λόγους διαφέρει. Τῷ μὲν γὰρ ἀρκεῖ τὸ βουληθῆναι τὸν Θεὸν κοσμῆσαι τὴν ὕλην, ἡ δ' εὐθύς κεκόσμηται πάντα γὰρ εἶναι τῷ Θεῷ δυνατά νομίζει, κἄν εἰ τὴν τέφραν ἵππον ἢ βοῦν ἐθέλει ποιεῖν. Ἡμεῖς δ' οὐχ οὕτω γιγνώσκομεν, ἀλλ' εἶναι γὰρ τινὰ λέγομεν ἀδύνατα φύσει καὶ τούτοις μηδ' ἐπιχειρεῖν ὅλως τὸν Θεὸν ἀλλ' ἐκ τῶν δυνατῶν γενέσθαι τὸ βέλτιον αἱρεῖσθαι.

Ogle summarises the evolution of the theory of natural selection from Aristotle to Darwin in these words:

The old philosopher (Aristotle) insists on the survival of the fit, Darwin on the survival of the fittest [16].

Darwin's thank you letter for Ogle's courtesy:

C. Darwin to W. Ogle

Down, February 22, 1882

My dear Dr. Ogle,–You must let me thank you for the pleasure which the introduction to the Aristotle book has given me. I have rarely read anything which has interested me more, though I have not read as yet more than a quarter of the book proper.

From quotations which I had seen, I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere schoolboys to old Aristotle. How very curious, also, his ignorance on some points, as on muscles as the means of movement. I am glad that you have explained in so probable a manner some of the grossest mistakes attributed to him. I never realized, before reading your book, to what an enormous summation of labour we owe even our common knowledge. I wish old Aristotle could know what a grand Defender of the Faith he had found in you. Believe me, my dear Dr. Ogle,

Yours very sincerely,

Ch. Darwin

Less than two months after this letter was written Darwin was dead.

Darwin may have stood - as some of his critics have argued - on the shoulders of others; such is the history of science.

But his perceptions of life and its evolution on

earth are convincingly his own. Stimulated from his observations on the shells of the tortoises and the beaks of birds adapting to the environment of the volcanic Galapagos Islands, he incubated his ideas for years and when necessary modified them, before he took the courage to put them in print.

In the Victorian era in which Darwin lived he needed the audacity to think otherwise and the courage to write what he did; like Aristotle he was accused of impiety.

Galen who often quotes Aristotle would have been surprised to learn that it took so long for the evidence on the origins of life to re-emerge through the pen of Darwin and his contemporaries.

But Galen lived in the epoch of a *Hadrian* and of a *Marcus Aurelius* when Greek thought prevailed; the times that Edward Gibbon proclaimed as the *"happiest era of human history"*.

Acknowledgement

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