

This is Biology

The Science of the Living World

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Mayr is a biologist. Biologists feel rather defensive about their discipline. Physicists on the other hand consider themselves on top of the scientific ladder, their science having had spectacular success from Newton, via Maxwell, Einstein to the modern Quantum pioneers. Mathematically elegant and compelling, universal laws, and addressing the very core questions of what the world is. What can biologists put up to compare? Are they not mere stamp-collectors, as the physicists dismiss them as? The biologists defend themselves that they after all study life not death. That biology is the science of life, a take that has been accepted as we nowadays speak about Life sciences. Physical science thrives on universal laws and is relentlessly deterministic. In life there is individuality as opposed to universality, there is not determinism only probabilities. And most important of all, life cannot be reduced to a lower level, at each level new phenomena appear which cannot be explained at a lower level. The phenomenon of 'emergence'. Basically life is intricately structured organization.

Now historically there was a struggle between physicalists and vitalists, Mayr explains. Both were wrong and both were right, in the end there was a third option, namely that based on above-mentioned 'emergence'. The physicalists wanted to explain biology by reducing it to physics. Descartes was an early proponent claiming that animals were mere machine, be they intricate such. Laplace envisioned an intellect that at a given moment knew all the positions of particles as well as velocities of the same, and hence would understand both the past and the future. A materialistic vision if any, no matter that it might have been offered tongue in cheek. The vitalists, on the other hand, treated life as a mystery, that it was based on different matter, or at least matter imbued with a vital force of some sort. Most of us, I suspect, experienced repulsion when we were told that we were made up of the same matter, atoms, as dead things. In fact vitalists did hang onto that conceit until it was shown in the early 19th century, beyond reasonable doubt, that life was made up of the same stuff as anything else. In short vitalists were invoking the supernatural, a deadly sin in science; while the physicalists were blinkered in their naive reductionism, unable to appreciate the subtleties of the real living world. One may say that all texts are made up by letters, but that does not go a very long way to explain the meaning of texts, of which nothing appears in the single letter themselves.

Now what is science? Mayr, who has the skepticism towards philosophers of a devoted naturalist with dirty hands, does not believe that the philosophers of science have the answers. What do they really know? As to philosophy of science, he believes that they are too hung up on physics. Biology needs another approach. Yet he points out some general features of all sciences, namely the rejection of the supernatural, as it has no explanatory value. He refers to Popper (so much in vogue during the 50's and 60's he reminds us) and

unlike Dawkins he understands what Popper is all about and seems to basically accept his position without falling into the trap of taking him too literally¹.

Now Mayr rejects the supernatural. It is not clear what this entails. In a world in which only gravity is known, electrical attraction is an unexplainable mystery and cannot be understood in terms of gravitation, which by itself is a mystery, more or less supernatural as Newton was well aware. And what is really understood by emergence? That new phenomena occurs at every new level non-reducible to the former. Thus not really explainable in terms of them either. Are we talking about new phenomena only accessible empirically, thus making biology supernatural in relation to physics, and in a sense occupying a different world, in contradistinction to a general conviction that there is but one world out there and it hangs all together. Now the only reasonable definition of supernatural is that it evades understanding and thus escapes any dialogue, providing the last word closing a door to further inquiry. Thus there will be a distinction between permanent supernaturality and provisional. The latter is inescapable in any honest science no matter how hard-headed. Understanding ultimately means submission to the deity of human reasoning. Thus science in the end is guided by human reason, by itself a rather innocuous statement, yet, and this is of course crucial, subjected to comply with empirical facts. In the philosophy of Popper, we formulate questions by human reasoning as well as interpreting the answers through the same mood. Thus human reasoning is not enough. This should be contrasted with the Baconian view, so much still the vogue among the general public, including politicians, in which nature tells us everything somehow making human reasoning superfluous. As to facts versus theories Mayr shows a certain confusion, seemingly contrasting irreducible and irrefutable Baconian facts with speculation. From a pure Popperian perspective, facts are about existence and single observations while theories are about universalities connected with long sequences of observations (with which the theory of Evolution is intimately connected). 'There is'-statements as opposed to 'for all'-statements. In logical jargon \exists as opposed to \forall . As long as a theory can be refuted by counterexamples it cannot be a fact. Of course the pure Popperian view is in practice fraught with problems, as there is no such thing as an entirely theory-free observation or fact. But in practice if the notion of fact is meant something we for all intents and purposes are not going to question during our investigations, it serves a definite purpose. Thus maybe a further illustration of Popper's injunction that one should not be too formally inflexible when it comes to meaning of words, but take a pragmatic attitude.

Now Mayr makes a division of biology through the asking of 'What', 'How' and 'Why'

¹ There is a minor quibble. Mayr, not unreasonably, thinks that concepts should be clearly defined, so in any discussion one should know of what one is talking about, in fact a common complaint about philosophers as to the pursuit of philosophy. While Popper only reluctantly would let himself been drawn into extended discussions about the precise meaning of words as ultimately sterile. In one essay he goes almost overboard in rejecting the need for precision, and ironically ending with a plea for one. Popper has obviously been nodding. Yet, Popper has of course a point, exact definitions being impossible and its quest counterproductive. As an example one may think of the words 'prediction' and 'understanding'. The former is amenable to some formal precision, after all it is crucial to Popper's quest of falsification, while the latter is not, and we are forced to rely on some common intuition. In Evolution predictability plays a minor role, while understanding is the major, as we will see further on.

questions. Of those the much disparaged 'What' questions are the most fundamental, historically as well as those questions that have attracted most naturalists to the subject. What is the living world? Meaning what are its objects and that problem is addressed by description, which still may make up the lions share of all activity in biology, because also the supposedly hard-headed subject of biochemistry is to a large extent descriptive Mayr reminds us. Fundamental to description is classification, in particular the notion of species, which is supposed to be a natural one, although the higher taxa may be more human conventions, although in view of Darwin's conception of the life tree of evolution by common descent, there is an ultimate classification. Now any classification has a purpose, and the purpose has to do with information retrieval, and thus the evolutionary one may not always be the most convenient. Mayr discuss downwards and upwards classification, the former designed for quick and efficient identification of species². There is also cladification in which latest branch points play the pivotal role. In such a scheme, cods are closer to humans than they are to sharks, because the lines that led to sharks split earlier than the one that led to mammals. Or more drastically, Charlemagne is closer to his present day descendants than he was to his siblings! The notion of distance between species is a subtle one, and is usually solved by comparing a long list of characteristics with suitable weights, which is subjective of course, but as such guided by reason in the guise of common sense is more robust and relevant than ostensibly objective ones based on algorithms and numerical criteria. The whole issue of homology that lies at the heart of the description of the living world gave the clue to evolution even before it was formulated. And of course the discipline of comparative anatomy, in which people like Cuvier and Owens excelled, would not be possible without the concept of homologies. Now true description cannot be divorced from considerations of how and why, this is why a drawing (not necessarily skilled) is superior to a photograph, as the salient features are given prominence. In order to be able to identify the salient features you need some understanding. Now with the microscope, which played almost the same fundamental role in biology as the telescope played in astronomy, one discovered the subvisible world which greatly extended the scope for description, the pioneers, such as Hook and Leeuwenhoek discovered cells as early as the 17th century. The close relationship between plants and animals only became apparent when both were discovered to be made up as cells. Cells thus being the basic building blocks of the organic world, with a rich inner structure, unlike that of the corresponding atoms of the physical and chemical realm. Significant advances in cellular biology came about in the 19th century when the battle between physicalists and vitalists rattled. One battle concerned the issue of cell-division, which leads us to a How-question, in the terminology of the author. Now there is of course no real significant difference between a What-question and a How-question when description is concerned, except that the latter is not necessarily as visual. Anyway at the end there was an understanding of the difference between the normal cell division of mitosis and the sexual one of meiosis, which led to the subtleties of the packaging of the genetic material through chromosomes and thus the mechanisms of inheritance. This would develop in earnest in the 1950's as a consequence of the elucidation on DNA and open the door to biochemistry. This is real science, in the view of the physicalists and

² Such an identification does not have to be natural to do its job, one may well envision one in which whales are lumped together with fishes!

their descendants, and no longer mere 'stamp collection'. And indeed it has opened the way to the ultimate 'How'-questions in biology. How does the coding of proteins given by the DNA-sequences translate into the building of the phenotype? In particular how does embryology proceed, that it is not entirely determined by the genetic information is clear from the phenomenon of conjoined twins, in which elaborate joined structures are created, not present in the code³. The understanding of how proteins eventually generate properties of the genotype is still very poorly understood, not something the general public appreciates due to the prevailing ideology of blaming everything on genes. Thus there is on one hand a very general, one is tempted to say ideological understanding, on the other hand a lack of knowledge of how things actually work out in practice. The devil is in the details, which has particular relevance to biology.

Now 'How'-questions are the essential ones to ask Popper teaches us, 'Why' questions on the other hand lead nothing, and he has in mind the teleology of an Aristotle. Mayr, however, he is undaunted and proceeds with 'Why'-questions supplied by Darwinism, without of course conceding any teleological view of evolution. While 'How'-questions can supply proximate causes, Darwinism actually supplies ultimate. As famously noted by Dobzhansky: Nothing in biology makes any sense except from the view of evolution. To talk about ultimate causes brings you close to take a metaphysical view, and indeed originally Popper thought of Darwinism in terms of metaphysics, for which he was criticized and hence he later recanted. However to Popper metaphysics was nothing inherently bad, after all in the spirit of Russell he thought of metaphysics as proto-science, and his own vision of science was metaphysical, by necessity one is tempted to add, and imbued by the spirit of Darwinism, thinking of theories as organisms struggling to survive and culled by the unforgiven facts of nature⁴. Mayr points out that in biology one has to take into account both proximate causes (as to how) and ultimate causes (as to why). One may remind the reader that biology as evolution is a historical science, and just as one in history may ask 'Why'-questions, which relate to the thoughts of the actors of history, meaning their motivations and wills, the same thing is true of evolution where one may look for explanations, never mind that evolution has no will, no thoughts and no motivations and thus undirected, yet this does not exclude that it works on certain principles which one may invoke. Mayr emphasizes, in that context, that in biology progress is due to new concepts, unlike physics and chemistry, when new facts are paramount. I find this a bit questionable. Progress in physics has certainly been driven to a large extent by new concepts, as in any intellectual discipline, and one is reminded of Gauss quip: What is needed are new notions, not new notation.

Mayr's primary interest was species and speciations, problems that led Darwin to his insights, thus a large, part of the book, larger than may be strictly justified, is devoted to the problem, and his emphasis on evolving populations. One of his insights is that evolution occurs at different paces, when a small part of the population becomes isolated

³ There are various models how this is done, involving feedbacks from adjoining cells. There are some mathematical theories, which when simulated give intriguing patterns, on rather simple principles. Fingerprints differ even among identical twins.

⁴ Popper was actually not above imparting to Darwinism teleological attributes, such that each individual possess by an urge to better their lives, and species striving for perfection.

from the main part, typically because thrown into a different niche, selection pressures are strong and liable to be readily imprinted, which means that the population will evolve more rapidly than normal. This is in accordance with the theory of Gould and Eldridge of punctuated equilibria, which in no way involves a modification of Darwinism, even if they may have thought so, but is in perfect compliance with it. In the end there are some sections dealing with applications, especially the role of humans in evolution and what it can tell us about a biological basis for morality, which is the weakest part of the book. Mayr claims that psychology is a part of biology, or at least will be subsumed in the future. In a way this is analogous to biology being part of physics, to which he is vehemently opposed. He does not enter into the matter for obvious reasons. Yet, one may of course speak about emergent phenomena of the human spirit if one deems fit, just as life transcends dead matter, may not the spirit, or the soul, transcend mere biological life? This may be thought of fanciful speculation based on the seductive practice of analogy, a way of arguing that Mayr warns against. Descartes was not able to stomach that the spirit would be reduced to mere matter, and Wallace stopped short of the human brain being the product of evolution, Darwin was more radical and courageous. And most of us still are repulsed by the idea of being able to explain consciousness in material terms, finding all the attempts to do so extremely unsatisfying. Thus the idea of strong AI to generate, no just simulate symptoms of consciousness, has so far been solidly rejected. To turn the spirit into flesh is a miracle, but one which to a large extent has been accomplished, but to turn the flesh into spirit is a miracle of miracles. Biblical quotes which may give comfort even to unbelievers.

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