MAYR ON SPECIES CONCEPTS, CATEGORIES AND TAXA

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Lately Peter Buerton (2002) has published a long historical commentary on Mayr's discussions of the biological species concept, to which is appended a very brief response by Mayr (2002). Among the many points that Buerton considers is that Mayr (1942, p. 120) emended his definition of 1940 to introduce the criterion of reproductive isolation while giving the impression there and elsewhere that no change had been made. Buerton (2002, p. 83, also 85) asserts that "the difference has never been noticed" but in fact it has (Ghiselin 1997, p. 95). Buerton does consider how this event relates to the issue of how much credit Dobzhansky should get for the biological species concept (See Dobzhansky 1935, 1937, 1940; Ghiselin 1997, pp. 93-94).

In his response, Mayr takes Buerton to task for not having clarified the confusion between species concept and species taxon. He points out that the term 'taxon' was introduced into the literature only around 1950, and says that just about everybody including himself confounded the concept, the category, and the taxon up until that time. He says that Buerton did not clarify the distinction between species taxon and species concept, and that "recent contributors to the species problem, particularly all the recent authors of phylogenetic species definitions, also fail to make this distinction." Readers will probably continue to find Mayr's own pronouncements something of a puzzle.

In this brief essay I will explicate what Mayr seems to be trying to say in his response to Buerton. Although Mayr makes eight comments on Buerton's paper I will only discuss five of them and will quote them in their entirety for the readers' convenience. I presuppose much of what was expounded at great length in a book that Mayr read in manuscript and was dedicated to him (Ghiselin 1997). Most important, perhaps, is the fact that biological species are, ontologically speaking, individuals rather than classes. That metaphysical point makes the difference between the category and the taxa more obvious. There are various locutions and

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analogies that also make it easier to explain such matters, and here I will introduce a notation that may also help. I will use different fonts when referring to categories and taxa: boldface Roman for the former, boldface Italics for the latter. Thus, instead of saying that species is a class but species are individuals, we can say that **species** is a class but ***species*** are individuals, and the fact that 'species' is both singular and plural is then somewhat more obvious. (Following an established convention I will use single quotes whenever it seems desirable to emphasize that what is being discussed is a word rather than a thing.) In the few cases where it seems desirable to make it abundantly clear that we are talking about what Mayr calls concepts, bold capitals will be used: **SPECIES**. We can continue to use other locutions as well. Expanding in this manner we would say that *the* **species** (category) is a class, but *a* ***species*** (taxon) is an individual.

We may begin with Mayr's first point, which is: "There are three combinations with the word species, species concept, species taxon, and species category. Confusion results inevitably if the three items are not recognized and sharply distinguished." The first sentence, which seems perfectly unobjectionable, may be re-written to illustrate the notation used here: There are at least three senses of 'species': **SPECIES** concept, ***species*** taxon, and **species** category. It is hyperbole to state that the confusion is inevitable, but it certainly is very common. That often happens when words are used equivocally (Ghiselin 1984).

Mayr might then have stated something like the following. A **SPECIES** concept is a definition of '**species**' and provides the properties that are necessary and sufficient for an entity to be a ***species***. This is the standard logical analysis and it seems to be at least approximately what Mayr had in mind. There are various problems, however, and one of them is that the **species** category is itself equivocal. The **species** is a level in a hierarchical classification system, and by a definition of 'the **species** category', one might mean nothing more than that. It would not provide the criteria that are necessary and sufficient for an entity to be a species, beyond occupying a particular level in some hierarchy in which that level occurs, *e.g.*, below the level of the genus. In the context of the Linnean hierarchy a **species** definition provides just those criteria. It provides the defining properties—in other words, the meaning, or intension, of the term '**species**'. However, '**species**' might be, and often is, used in more than one sense. In other words, several definitions might be used for '**species**'. The biological species definition is of course just one of these.

Mayr's second point, an attempt to explain what is meant by 'species concept' is a bit more challenging. He begins: "A species concept is the description of the role a species plays in the household of nature." It is difficult to make out the meaning of this assertion even if we make use of the notation adopted here. Does he mean that the **SPECIES** concept de-

scribes the role that **species** plays in the economy of nature? That would make very little sense, because **species**, being a class and therefore an abstraction, cannot engage in processes, including playing a role in the household nature. Or does he mean that a **SPECIES** concept describes the role or roles that ***species*** play in the household of nature? The role that a ***species*** plays in the household of nature suggests its ecological niche. I doubt that he means by this that '**species'** is defined in such ecological terms, although he once ventured something along those lines.

Perhaps what Mayr really had in mind is that a **SPECIES** concept is a definition of '**species**' in terms of the role that ***species*** play in evolutionary processes. What role? Of course they do all sorts of things, such as evolve and become extinct, but so do taxa of lower rank, such as local populations. What really matters is that they speciate. Species are the concrete particular things (individuals) that speciate. That is what 'species' means; in other words, that is its definition. Of course, words are always defined in terms of other words, so to understand what '**species**' means one has to know what 'speciation' means, and if the definition is not to be circular one has to be careful. I have repeatedly suggested that treating '**species'** as the class of what we might want to call "speciators" is perhaps the best way to define that term (Ghiselin 1974, 1997). We need to recognize that '**species**' is a theoretical term, and that its intension is determined by its role in theory (rather than the household of nature, although that might be an adequate metaphor). Furthermore, '**species**' is a natural kind term, and like other natural kind terms such as 'molecule' and 'organism' it is very difficult to find a straight-forward and simple verbal formula that does justice to its intension (*i.e.*, the defining properties).

Expanding on the same point, Mayr continues: "Of all the numerous so-called species concepts, only two qualify under this definition, the typological and the biological species concepts. All others are merely specifications by which to recognize species taxa." It is far from obvious what role if any the typological concept of **species** or its member ***species*** might play in the household of nature or in evolutionary processes, though of course both the morphological and the biological concepts are definitions of the category. His second sentence is fairly easily explicated, although I am not sure how far most of us would agree with it. Among the various supposedly competing species concepts, many are easily dismissed as synonymous (Ghiselin 1997). In spite of the category being defined in somewhat different ways, it has the same taxa as its members. However, there are some definitions of the category that are not synonymous by that criterion. For example, in some cases the taxa are parts of biological ***species***. For this reason Mayr's effort to dismiss phylogenetic species concepts as synonyms of the biological or the typological is not quite successful. The sterility test would evidently qualify as one of the

"specifications by which to recognize species taxa" rather than the definition of a "physiological species concept."

Passing to his third point Mayr explains the difference between the typological **SPECIES** concept and the biological one. "According to the typological species concept a species is a population (or set of populations) distinguished by a concrete characteristic. According to the biological species concept (BSC) a species is an aggregation of populations with the qualifications for free interbreeding." It is problematic whether there is any one such thing as "the" typological **SPECIES** concept. At any rate, at least some typological **SPECIES** concepts do not treat **species** as a class of populations, but rather as a class of classes of organisms, and the amount of difference between the organisms and those of other ***species*** is the criterion of rank. Given that ***species*** are populations, and that they may have component populations as their parts, it makes sense to say that a biological ***species*** is an aggregation of populations. However, being such an aggregation is not logically necessary given the biological **SPECIES** concept, for a ***species*** can consist of just two organisms (or indeed even one). By analogy, most of us would not define 'organism' such that it has to be a part of a multicellular one. In theory one might have one **SPECIES** concept such that a species must have more than one component population and another such that it can consist of just one, and in this case there would definitely be two such concepts. Unfortunately, 'population' is another word that has often been used equivocally, so that it is not always obvious that not just local populations, but entire species as well, are populations. Mayr's ambiguity about that must have confused many of his readers down the years.

Mayr then continues: "Asexual 'species' do not qualify as such under the BSC. They are, as agamic species, delimited typologically, but are placed with biological species in the Linnean species category." In other words, given the biological **SPECIES** concept, no agamic "***species***" has the defining properties of **species**. And the reason, although Mayr does not state it explicitly, is that sexuality is a defining property of 'population'. For typological species concepts, being a population is not a defining property of 'species'. I would add that there is a serious question as to whether it is desirable to bend the knee to scholasticism by treating "agamospecies" as if they were the real thing.

Mayr's fourth point deals with what is meant by '***species*** taxon'. "A species taxon is a group of natural populations jointly qualifying as belonging to one species under the term of a species concept." Provided, in other words, that the defining properties of **species** include being a group of natural populations, then any such group that has this and the other defining properties of **species** is a ***species***. Mayr's next sentence, although somewhat puzzling, is more interesting, as it was perhaps influenced by

one of my earlier publications (Ghiselin 1984). "The delimitation of the populations which belong, or don't belong, to a species taxon is guided by the diagnostic criteria of the used species concept." Because biological ***species*** are individuals, not classes, they have no defining properties. The properties that are used to tell whether an organism is a component of a particular ***species*** are called "diagnostic" rather than "defining" to make it clear that they are criteria of inference, and not logically necessary. Usually 'diagnosis' is not used for the properties by means of which we decide whether a population is a member of **species**, *i.e.*, a ***species***, but there is no compelling reason for not using 'diagnostic' in this context. Thus, morphological distinctness might be a diagnostic property for biological **species**, because it would be legitimate evidence, but it would not be defining because it would be neither necessary nor sufficient for defining the name of the category.

Mayr then proceeds to his fifth point: "A polytypic species is a kind of species taxon, it is not a species concept (contra early papers by Mayr)." Saying that the polytypic **species** is a kind of ***species*** taxon may seem an odd way to make the point that it is not an alternative definition of **species**, but a subclass of it at the same level. All polytypic ***species*** are ***species***, though not all ***species*** are polytypic. (A committee is a committee irrespective of whether it has one member or many.)

In evolutionary theory the biological **species** is a natural kind. It is a class to which reference can be made in laws of nature. Its members are ***species*** and, being individuals rather than classes (kinds), there are no laws of nature for any one of them. The laws of nature in question are about kinds, in other words, classes, of ***species*** and classes of speciation processes. The confusion between categories and taxa is part of the reason why Mayr and others failed to recognize the existence of laws of nature in biology.

It is imperative for the prosperity of science that the word '***species***' be used in precisely the same sense in taxonomy as it is in the study of evolutionary mechanisms. Having a system of classification in which the units of systematics are identical to those of population genetics is essential for clear thinking about biology in general. Defining **species** morphologically or, if you prefer, typologically, does not provide a unit that meets that requirement. Treating the **species** as if it were nothing more that a level in a variety of logically possible hierarchical arrangements may entertain the logician, but it will not help a biologist to solve scientific problems. Defining the **species** disjunctively, so that it means either 1) a class of population-level individuals or 2) a class of classes of organism-level individuals, may please the bird-watcher, but it can only muddle the thinking of an ornithologist.

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