THE BIOLOGY AND PHILOSOPHY

OF ADAPTATION

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Abstract

A logico-linguistic analysis is presented first, in which the symbolization of being adapted, having an adaptation, and having adaptedness is explained. Next the linguistic-realistic divide is portrayed. This is explained as 'adapted' the word being true of some '*x*' and 'adapted' the word referring to an external entity adapted. The external entity adapted is true of some real organism *x*, and this organism exemplifies the property of being adapted. Finally, the external world of properties is portrayed. Thus the property of overwintering in angiosperms by bare limbs, seeds, and underground parts dictates winter adaptedness; the property of spring-summer growth of leaves, of annual plants and of above-ground parts dictates summer adaptedness. Also the property of overwintering in diapause insects and in hibernating mammals and southern flying birds dictates winter adaptedness, while the property of spring-summer growth and activity of non-diapause insects, of non-hibernating mammals, and northern mating birds dictate summer adaptedness. And year-round functionality dictates year-round adaptedness and year-round non-functionality dictates year-round non-adaptedness, exemplifications of the first pair being in non-hibernating mammals and of the second pair being in cold-blooded vertebrates and gymnosperms.

Introduction

For a biologist any diatom or any oak exemplifies the property of being photo-synthetic. For a philosopher DeGaulle exemplifies the property of being courageous, the property or universal of courage. Then, too, the property of being a color is exemplified by the property of redness, exemplified in turn by a rose. And it might be supposed that the property, in St. Anselem's parlance (1974, pp. 7-10), of being that than which a greater cannot be conceived is exemplified by the Nazarene and additionally by any of us and anything else down to the last microparticle in some most remote vista of the universe – our universe, that bit of thistledown adrift in the midst of nowhere.

Briefly, the property of being photosynthetic is exemplified by a diatom, the property of being courageous is exemplified by DeGaulle, the property of being a color is exemplified by a rose, and the property of being the Supreme Being, conjecturally, is exemplified by any being, any thing.

And so in the study presented next exemplification of properties will be important. But the view will be narrowed to two approaches to adaptation, where properties and their exemplifications are paramount.

The two approaches to adaptation will be intermingled in this essay. The first approach is linguistic. This approach is one that is involved with the logical symbolization of adaptation, because logical procedures are invariably linguistic in

structure. The second approach is concerned with adaptation in the external world. This approach will employ philosophical considerations primarily. Both approaches will involve universals, which include properties, kinds and relations.

The Linguistic, Logical Approach

In the next few paragraphs a bringing together of sentence structure, its symbolic representation, and a description of three aspects of adaptational structures will be presented. The intertwining of these venues is to be appreciated by delineating the three aspects of adaptational structures in a simple manner. The three aspects are the following:

1. *x* is adapted to *y*,
2. *x* has an adaptation *z* to *y*,
3. *x* has adaptedness *z* to *y*.

These all express the same issue. But their structure is quite different. Their structural difference reflects the deepest philosophical issues. Whether 1.-3. occur as affirmations or denials (not adapted, etc.) these issues are apparent, as will be seen next.

Dobzhansky (1968, p. 6) provides two examples of natural history with the different wording of 1. and 3. He says "Man is not adapted to feed on pasturage, while horses and cows are so adapted; palms and bananas have no adaptedness to live in Canadian forests, while larches and spruces do have such an adaptedness……" There is

the important structural change from “is not adapted to,” as in 1. (denied), to “have no adaptedness to,” as in 3. (denied).

To see the change in structure another example is concerned with the traits of the eastern woodchuck as described in Hulburt (1992) taken from Barash (1978, pp. 57-60). One trait is a rapid sexual maturation of two years. Thus for all woodchucks there could

be many traits of a two-year maturation, one for each woodchuck or one trait of a two-year maturation shared by all woodchucks. Changing maturation to maturity increases the feeling of one shared trait. Since the woodchuck is adapted to a lowland environment, its rapid sexual maturation is an adaptation to such environment. So, for all woodchucks there could be many adaptations, one for each woodchuck, or one adaptation shared by all woodchucks. Changing adaptation to adaptedness increases the feeling of one shared adaptation. Further, for each woodchuck there can be the linguistic ‘*x* is adapted to a lowland environment *y*’ or there can be the linguistic ‘*x* has an adaptation *z* to a lowland environment *y*’ or there can be the linguistic ‘*x* has adaptedness *z* to a lowland environment *y*’. The change from ‘is adapted’ to ‘has an adaptation’ or ‘has adaptedness’ is from referring to many real adapted organisms to referring to many real adaptations, just as many as there are organisms – or to referring to one real shared entity, adaptation. Then, next, the shift from adaptation to adaptedness, like maturation to maturity is a shift, for sure, to referring to just one shared real though abstract entity. Words ending in ‘ness’ indicate singular reference Quine argues (1963, pp. 72-78: 1960, pp. 118-120), an argument reiterated by Wolterstorff (1970, p. 68).

Adaptedness is a single abstract entity. Adaptedness, like maturity, is an abstract entity that becomes part of concrete particular entities. Adaptedness, like maturity, is a property, one of the three sorts of universals. Universals are with us today (Loux, 1970) as they have been down the centuries, subject to argument then as now (Copleston, 1962, pp. 157-176). But if we endorse their existence and commit ourselves to a realm of abstract entities, then when Dobzhansky says larches and spruces do have adaptedness (to

Canadian forests), we must see in this a commitment to there being the universal adaptedness. Thus, for each larch or spruce there is adaptedness to Canadian forests which each has (and each has it).

As just mentioned, the development here includes a step in which 'is' is switched to 'has'. The structure '*x* is adapted to *y*' is '*Axy*', that is, 'adapted' the word is true of the linguistic '*x*', which in turn refers to one single organism *x* in the external world where this organism really is adapted to *y*. But the structure '*x* has an adaptation *z* to *y*' dictates as a procedure a symbolization as '(*3z*)(*Az*·*Hxzy*)' as in 2. In words this is: 'There is a *z* such that, *3z*, *z* is an adaptation, *Az*, and *x* has *z* to *y*, *Hxzy*'. Again the word 'adaptation' is true of '*z*' when '*z*' refers to one external entity *z*, which really is an adaptation, and the phrase '*x* has *z* to *y*' refers to three external entities where the first really has the second to the third.

The external biological world is described often by its adaptations, where an adaptation figures as a generalizing entity and as a means in carrying out a generalizing program. Here is an example. "The webbed feet of a duck set toward the rear of the body represent an adaptation for swimming; the strong talons of an owl are an adaptation

for clutching prey; the opposable front and rear toes of the warbler are an adaptation for perching on branches…." (Grant, 1963, p. 95). The last is 'For every warbler there is an adaptation of opposable front and rear toes for perching which each has' or 'Every warbler has an adaptation of opposable front and rear toes for perching'. An adaptation helps in generalizing among ducks, owls, and warblers, so that although each duck, owl or warbler has its own adaptation, adaptations are what they have in common. Further

generalization ensues when the switch from 'an adaptation' to the universal 'adaptedness' is made. If both 'an adaptation' and 'adaptedness' are procedurally quantified as '3*z Az*' and 'has' is symbolized in '*Hxzy*' we have a smooth format in (*x*) (*3z*) (*Az*·*Hxzy*) for both 2. and 3., where (*x*) stands for 'for every warbler *x*' and the whole symbolizes 'For every warbler *x* there is an adaptation *z* (adaptedness *z*) of opposable front and rear toes for perching and each *x* has *z* to *y*'. What an adaptation or adaptedness is to, *y*, will come up next.

Universals, property universals, generalize the objectivity of our description, as mentioned. Let us see in detail how this works. Kricher and Morrison (1988, pp. 141-143) say that for the eastern woodchuck hibernation is to be considered an adaptation to winter. Consider a world of 10 woodchucks, 10 or one adaptations, and one winter: 21 entities at most. The uncertain 10 adaptations can be generalized to one for sure by adaptedness instead of adaptation. Each woodchuck has adaptedness to winter. Now there are 12 external entities which are referred to by the words 'woodchuck', 'adaptedness', and 'winter' – words which are true of, or denote, '*x*', '*z*', and '*y*', linguistic variables which have real counterparts which are identical with the real entities

woodchuck, adaptedness and winter – so that each woodchuck really does have adaptedness to winter. In symbols, with *x* identical with a woodchuck, *z* identical with adaptedness, and *y* identical with winter we have $(x)(\exists z)(\exists y)(Az \cdot Wy \cdot Hxzy)$, as in 3. No single quotes now. So the arresting issue is that *A* and *z* are not two but one, that *W* and *y* are not two but one, just as *x* is one.

Key points to note in this section are the suffix 'ness', the switch from 'is' to 'has', the words 'referring' and 'true of'. An issue of importance is the externalization of the linguistic variables, '*x*', '*z*', and '*y*' so that they are absorbed into the external world. The importance of this is discussed next.

The Linguistic – Realistic Divide

When *x* really is adapted, it is inscrutable to claim that 'adapted', just a word, could be true of or denote a real entity *x* in the external world, I below. A similar case is this: "'Rabbit' denotes $x \cdot \equiv \cdot$ [just in case] *x* is a rabbit" (Quine, 1995, p. 65). This quotation is based on Tarski (1983) and is meant to capture Tarski's system of predication, wherein (as far as I can tell) a higher level of predicate structure (more variables) connects to a lower level (fewer variables) through connecting the predicate of higher level with variables of lower level, here *x*. This is precisely what is done by the austere nominalist, one who does not countenance the reality of predicates referring to properties, as explained dispassionately by Loux (2003, p. 64). "The fact that 'Socrates is courageous' manages to tell us how the world is depends upon the fact that (i) its subject term, 'Socrates', means a certain object, (ii) its predicate term, 'courageous', is true of or

satisfied by certain objects, and (iii) the item named by its subject term is one of the items satisfying its predicate term." Here it is pointed out that the linguistic 'courageous' is true of certain real objects. This is false, because upon reflection one sees that only a real courageous could ever be true of and thus characterize the real object referred to by the linguistic 'Socrates'. If the world contained only the real uncharacterized counterparts to

'Socrates' and others, we would have a world of uncharacterized objects, a twilight, somnambulistic jumble of amorphous wraiths.

Going back to the quotation from Quine, 'rabbit' the word denotes a real *x*, just in case this real *x* is a real rabbit, I below. This is an inscrutable bridging of the linguistic-realistic divide, because 'rabbit' the word is true of or denotes a linguistic '*x*', see II. In order to bridge the divide the linguistic '*x*' refers to a real *x* and the linguistic 'rabbit', the word 'rabbit', refers to a real rabbit, which is true of or denotes a real *x*. The same is true of 'adapted', which must refer to real *adapted*. Thus entification of 'adapted' ('rabbit') comes about only by referring – that is, if 'adapted' the word is true of or denotes the linguistic '*x*', then the real world referent adapted is true of or denotes the real world referent *x*, as shown below in II. The real world referent of 'adapted' is not *x*. I is wrong.

If one describes the biological world honestly, *adapted* is a salient reality of it, a reality merely emphasized by the more clearly drawn entifications of adaptation and adaptedness. These entifications defy being separated from variables, as presented previously and shown below in III. Variable and property in the real world are one in the case of adaptation and adaptedness.

	I	II	III
Linguistic World	'*A*'	'*x*' ← '*A*'	'*x*' ← '*A*'
	↓	↓ ↓	↓
Real World	*x* ← *A*	*x* ← *A*	*Ax*

Horizontal arrows = true of, denotes, predicated of

Vertical arrows = refers to

Wolterstorff (1970, pp. 63-86) describes the linguistic-realistic divide directly. One is to accept all mention of predication as not linguistic primarily but as objective description of the external world. Thus modifying his examples of p. 64, we get: when '*x* is adapted to *y*'; *x* is referred to and *adapted to y* is predicated of *x*; *x* is referred to and *being adapted to y* is predicated of *x*; *x* is referred to and *adaptation to y* is predicated of *x*; *x* is referred to and *adaptedness to y* is predicated of *x*. So *adapted*, *being adapted*, *adaptation*, and *adaptedness* are all predicables and are structures of the external world. Thus, too, these predicables are true of or denote *x*. These are constituents only of the lower half of II above, which are referred to by the constituents of the upper half in '*x* is adapted to *y*'. This is a major feature of metaphysical philosophy of the 20th century.

The linguistic-realistic divide in all three cases, wrong in I, right in II and III above, is indicated by presence then absence of single quotes. This feature was brought into prime focus by Tarski in 1929 (in the reference below). Tarski used the maneuver of disquotation to indicate the shift from linguistic to real world description. His interest in this maneuver was to define what truth is. His example (Tarski, 1983, p. 156) is: " 'it is

snowing' is a true sentence if and only if it is snowing", In this way we get truth, if 'it' refers to it and 'snowing' refers to snowing.

The Philosophical, Objective Approach

The delineations just made can be made in a very different way. First, the philosophical status of the general term *adapted* and the abstract singular term *adaptedness* is this: the general term *adapted* is true of all and only those organisms or

species that exemplify the property picked out by the abstract singular term *adaptedness* (Loux, 2003, p. 31). Certainly we have again a generalizing mechanism.

This philosophical approach will be adhered to in the ensuing discussion. Then, what is the philosophical status of the term *adaptation*? If one endorses the view of the metaphysical realist (Loux, 2003; Moreland, 2001; Armstrong, 1989), the view that particular organisms possess the properties that compose them, then these are common properties that are repeated from organism to organism, from species to species. Such a property is adaptedness. This single property is exemplified, is instantiated in each duck, each owl, each warbler – and in each duck species, each owl species, each warbler species in Grant's depiction just presented. These exemplifications of adaptedness in the various animals are whole body exemplifications. But when Grant says "The webbed feet of a duck set toward the rear of the body represent an adaptation for swimming," *adaptation* here is a *property* exemplification (instantiation) of adaptedness. Adaptation here is the representation of the property adaptedness in some morphological part of the organism.

The derivation of the viewpoint of the metaphysical realist (following closely Loux 2003, pp. 26-27) is as follows. Suppose it is said 'the white spruce is adapted to Canada'. Corresponding to this *subject-predicate* linguistic structure is the real, external world structure of *particular-property*. The subject 'the white spruce' is a linguistic element and refers to a real element, a single though scattered entity, the white spruce. This entity is a particular, a particular broadly speaking. But the predicate 'is adapted to Canada' has referential force in that 'adapted', a general term, refers to, picks out an

abstract singular entity, adaptedness, and this single entity accounts for the fact that the repeated use of the general term has precisely the same effect. This is the same as II in the section in the linguistic-realistic divide. But the next statement is somewhat different, bringing us back to exemplification mentioned first in this article.

"What makes a subject-predicate sentence true is just that the referent of its subject term exemplifies the universal that is the referent of its predicate term" (Loux, 2003, p. 27). Thus linguistically a general predicate term is true of a subject term. But objectively in the real world the referent of the subject term exemplifies the referent of the predicate term, if this term's referent is singular and abstract. This is shown as follows.

IV

Linguistic World	'*x*'	←	'*A*'
	↓		↓
Real World	*x*	→	*A*

Vertical arrows = refers to; upper horizontal arrow = true of; lower horizontal arrow = exemplifies, possesses

The switch from the general term to the abstract singular term has the following explanation (taken from Loux, 1978, p. 34; Moreland, 2001, p. 15). The linguistic general term has in the first stage multiple real references, for these are true of many real non-linguistic entities. But additionally it has a singularly real referring aspect, so that a second stage can be discerned. Thus *x* possesses *an* adaptedness (see IV), *one for each real entity*, for if *x* possesses *an* adaptedness, this means *x* possesses one of many and it means, too, *x* possesses exactly one. Choosing the second option, this second stage leads

to a third stage, wherein entity *x* possesses adaptedness, a numerically single abstract constituent of all entities that exemplify it, that are its instances. This is the full-blown stage of the metaphysical realist. It contrasts with the view of the austere nominalist, a view expressed by the fallacious I.

When in the case that adaptedness to Canada is involved, pure adaptedness is excluded. Adaptedness to something makes adaptedness an impure property, an impure trait. Once this feature is admitted, it is an easy step to see *x* having adaptedness to *y* as a relation. And this parallels *x* is adapted to *y*, a direct relation between *x* and *y*, taking us back to 1. in the linguistic section.

Thus, summarizing, we have a property, adaptedness. This is "a multiply exemplifiable abstract entity that is a numerically identical constituent in each of its instances" (Moreland, 2001, p. 74). The use of 'adaptation' will be to refer to property instances of the property adaptedness.

Properties

We will rely on such late twentieth century critical delineations of properties as those given by Jackson (1977), Loux (1970, 1976, 1978, 2003), Wolterstorff (1970), Armstrong (1989), and Moreland (2001).

Two basic schools of thought view properties in two basically different ways. One school is the moderate nominalist or trope school. Here properties are confined to the particulars that have the properties, which in turn compose, constitute the particular. Here properties of similar particular things are similar; similar properties of similar things form a similarity set – the adaptednesses of different organisms form a set of

adaptednesses. Each organism has its own adaptedness, as mentioned previously in the derivation of singular reference from general terms.

The other school insists that properties are not confined to particulars; this school is the metaphysical realist school. Here a single property, adaptedness say, is repeated from particular organism to particular organism. The adaptedness of flying is repeated, is instantiated in this bird or that bird, in this bird species or that bird species. Such a numerically single property is instantiated, is exemplified not just in different organisms and species. A numerically single property, or characteristic, can be exemplified, by a species in different ways: there is adaptedness in division rate to ten different temperatures by two algal species (Hulburt, 2002). There is multiple exemplification of the numerically one property in numerically ten aspects of these species. And the question is: how can the realist see his way to their being this multiple exemplification? If the realist can accomplish this, the advantages are enormous. One entity, adaptedness, would integrate the multiplicity of biota and their processes into one whole.

At first it was said that universals, properties, generalize our descriptions. Now it is said that properties integrate the biota being described.

Thus, if we assume a full-blown realist view, what character would a property such as overwintering have? The answer is very simple. There is agreement among the organisms, the species, the groups that overwinter: they all have special features for getting through the winter. Thus because many entities simultaneously overwinter, the realist is confident that one and the same universal is exhibited or exemplified by a multitude of plants and animals or by many species of plants and animals. But to

champion this audacious scheme wholly, the realist is forced to avow a non-spatio-temporal view, because one thing cannot simultaneously be in several places – one universal, if it is a physical, cannot occur in its entirety, in non-overlapping, discontinuous regions at the same time. But there is no difficulty with overwintering, because the character of overwintering, like adaptedness, is not spatio-temporal in itself. In itself it is incorporeal. Overwintering and adaptedness are incorporeal but enter into the things that have them, just as being north of is incorporeal and abstract in itself but does enter into the cities in the case that Edinburgh is north of London – Russell's (1912, 1997) well-known example. But physical properties can and should be treated as abstract, not just to be consistent but to promote an insight into the nature of a property. Then when such properties enter into particulars they are concrete exemplifications.

Thence a numerically single, unifying universal when entering into a particular, even a diffuse particular such as a species, dictates a structure for the particular. Suppose we consider one oyster; if it is like other oysters it pumps through its gill system 9 liters

of water in one hour between 16º and 28ºc (Loosanoff, 1958; Hulburt, 2002). This is an attribute, a property of oysters in general, this pumping rate. So on the one hand constituents such as gills, digestive system, shell, adductor muscle, etc. are tied together by intercellular stickiness; on the other hand constituents such as pumping rate are tied into the physical stuff by a metaphysical glue. The rate in itself is as diaphanous and incorporeal as being north of or adaptedness or overwinteringness. And so there must be a metaphysical tie that ties together the instances of corporeal properties, such as gills, and the instances of incorporeal properties, such as pumping rate. The tie and properties

are transmitted to all oysters, to the collection of all oysters, to the kind of thing that an oyster is.

Now there must be, one school of realists theorizes, an individuating principle to account for each oyster. There is no trouble in telling one oyster from another; of all animals they are the most easily distinguished from each other. But this distinguish-ability should be accounted for in constructing ontologically an oyster from the basic materials of properties and tie. And so we should have an individuating element, an element variously labeled bare substrate, bare particular, individuator – in the view of the substrate-attribute realist. This element is also a propertyless bearer of properties, for it is tied to the properties, to the instantations of properties, to be exact. When we say that a particular has such and such properties, this is the element that does the having, the possessing of the properties.

But a certain possibility has to be guarded against, which is what the propertyless individuator does. Suppose man-made objects, like two samples of the same shade and

brand of paint, are considered – these two samples by having the same properties (same shade, same chemistry) would be the same, would be one and not two, if it were not for the individuating propertyless bearer of properties. And it cannot be the case, the realist argues (Allaire, 1965) that the samples are two by location, one to the left of the other, for example, for numerical difference must occur first in order for location difference to occur second. Of course, although we have managed by the device of the individuator to keep the two samples of paint two, they are totally alike; they are, to use a technical phrase, qualitatively indiscernible. A further point is the possibility that natural objects

might conceivably be exactly alike; two squirrels perhaps could be exactly alike, or qualitatively indiscernible.

The individuator is not the only way that something can have or possess properties. If a core collection of instantiations of properties is bound together by intercellular stickiness plus a tie to hold on to the instantiations of the nebulous, incorporeal properties (rate of pumping, rate of growth, rate of cell division) this core collection can be repeated. Each repeat, each organism, is a whole. Each can possess extra, ephemeral properties, which are accidental and contrast to the essential properties of the core. The variety of shapes of the oyster are accidental but the thick, bivalve shells are essential. But each whole, each repeat is a member in a kind, which is a species. And species can be members in a further kind, a genus. And genera are members in the kind, family. And so on, to still larger taxonomic categories.

The way that initial taxonomic categories come about ontologically, is by the break-down of the identity of indiscernables. This principle requires properties, which

includes the view of the metaphysical realist. The principle says that "if two things have the very same properties, then they are the very same thing" (Armstrong's succinct words, 1989, p. 66)[1]. But as pointed out above in the case of the paint samples the two things can be kept two by an individuator, but they will be exactly alike. This happens in machine-made things. But natural things, the individuals of a species, seem usually not to be exactly alike. Consider, then, the gray squirrels of North America. Already they

[1] Symbolically we have $(x)\,(y)\,[(P)\,(Px \equiv Py) \supset (x = y)]$, which is for all x and y, if x and y have all and only the same properties, then they are identical to each other.

do not share all the same properties, since there are 5-6 subspecies (Pratt, 1935; Steele and Kaprowski, 2001). Somewhat less sharing of properties happens between gray squirrels and fox squirrels, for these two species have a different number of premolar teeth. So speciation is an initial taxonomic category process and is obviously an identity of indiscernables break-down.

The biologist's species has a dual role in that a species is a single, scattered thing, like a dealt deck of cards, a broken plate, the plankton, the Milky Way. A species is also a kind – closely akin to a class, a set – of which the pieces, the organisms are members. A further point here is that although the species is a scattered thing, the pieces transmit from the metaphysical structure of properties, tie, and individuator the property portion to the species – each redwood has tallness, the species redwood has tallness. And although the identity of indiscernables may be broken down initially to provide species, only a few physical properties are left in an exhaustive break-down to provide for the great classes, mammals, birds, reptiles, amphibian, insects, angiosperms and gymnosperms. However,

the non-physical, incorporeal properties cut across in an uncorrelated way these taxonomic groups. This will be clear in what follows:

Winter and Summer Adaptedness

There are various groupings when only the properties of overwintering, of spring – summer growth, and being adapted (adaptedness) are to be exemplified, instantiated. The property adaptedness will be seen to be the inclusive property. Next are these groupings for land biota in temperate regions. These groupings are properties of a

property, just as red is a color tells us that the property of redness is a property of coloredness.

1. Overwintering by bare limbs
2. Overwintering by seeds
3. Overwintering by underground parts
4. Overwintering by diapause stages
5. Overwintering by hibernation

1-5 are exemplifications, instantiations, of the property of overwintering. Overwintering is exemplified by each bare limb of every deciduous tree. Each seed of each annual plant instantiates overwintering. The property of overwintering is embodied in all underground parts of perennials. An insect's larval diapause stage is an instantiation of the property of overwinteringness. Mammals when they hibernate multiply exemplify the biological characteristic of overwintering.

All these instances are substance instances. Each instance, each exemplification, is a whole tree, a whole seed, a whole underground part, a whole diapause (larval) stage, a whole sleeping (hibernating) animal. Property instances are radically different, as discussed previously. There is overwinteringness of each one of these entities (tree, seed, etc.) – all these overwinteringnesses are property instances and are constituents of the whole tree, whole seed, etc. And further, these overwinteringnesses, taken apart from the organisms they are in, are indistinguishable from each other and simply revert to the numerically single property, overwinteringness.

Overwinteringness, the property of overwintering, is related to the further property, the property of winter adaptedness. The relation, it was just said, is such that overwintering is a property of the property of being winter adapted. There is, I think, nothing strange here. We just have a simple sequence, with winter adaptedness a capping property, a terminal universal. But this sequence is such that overwintering dictates winter adaptedness necessarily, just as redness dictates coloredness necessarily.

Then for the spring – summer growth and activity property that the land biota has there are these groupings.

6. The spring-summer growth of leafy limbs
7. The spring-summer growth of annual plants
8. The spring-summer growth of above-ground parts
9. The spring-summer growth of non-diapause stages
10. The spring-summer activity of non-hibernation

6 – 9 are instantiations of the property of spring-summer growth, wherein 6. is for deciduous trees, 7. is for annual plants, 8. is for perennial plants, 9. is for winged, non-diapause insects, and 10. is for active mammals that do hibernate. These instantiations, these instances, are substance instantiations.

Spring-summer growth is a property of the property of spring-summer adaptedness. So spring-summer growth dictates spring-summer adaptedness necessarily.

In this section there is only affirmation of adaptedness. In the next section only affirmation of adaptedness will be the result also.

Reciprocal Adaptedness

Birds are to be considered separately. The striking aspect of most manuals on birds is that every species has a picture of the species and a map showing the area where it is found. So it has adaptedness to the area of its occurrence, otherwise it would not be there. Now let us think of a single but different case. You get the ground ready for the plants you are going to plant in your garden – you make the ground adapted to the plants. Then you plant the seeds or plants and if they come up or do well they are adapted to the ground. In this two step way you can see that the plants are adapted to the ground which is adapted to them. And this reciprocal adaptedness is necessary, otherwise the plants would not be there. Likewise with birds and their areas of occurrence. For bird species that do not migrate each species is an instance of the property of reciprocal adaptedness with respect to its area of occurrence, both when it is breeding there and when it is not breeding there. For birds that migrate there are northern breeding areas where the species

are instances of reciprocal adaptedness and southern wintering areas where the species are instances of reciprocal adaptedness. That is, the species multiply exemplify reciprocal adaptedness when breeding and when not breeding.

More generally birds exemplify the property of overwintering when they are not breeding and often in southern areas and they exemplify the property of the spring-summer correlate to growth when they are breeding and often in northern areas. Thence overwintering – southern – non-breeding dictates winter adaptedness necessarily and northern – breeding dictates summer adaptedness necessarily.

Only affirmation of adaptedness is the result here. But in the next section both affirmation and denial of adaptedness seem to be the appropriate interpretations.

Adaptedness and Non-Adaptedness

Angiosperms, insects, hibernating mammals, and birds have been described by properties which are constituents of each organism's structure. Constituents include properties, the tie, and the individuator, which is that property-less bearer of properties. But properties are the crucial constituents, and very few of them are relevant to the description at hand. What is needed are properties that describe several more large groups. And it is noticeable that the organisms described so far have very distinct morphological or physiological differences between winter and summer forms, so that there could be both winter and summer adaptedness. But other organisms lack any difference between winter and summer forms. Gymnosperms and cold-blooded

vertebrates on the one hand and non-hibernating mammals on the other hand are such groups of organisms in temperate regions.

Let us consider the property of being year-round functional in the sense that the organism is metabolically and behaviorally active year-round - this would be in a non-hibernating mammal. Therefore this property, instantiated in each such animal could be a property of the property of year-round adaptedness and thus dictate the property of year-round adaptedness. Then let us consider the property of not being year-round functional – getting through the winter in a moribund or inert state and only coming to life, so to speak, with the return of spring and summer. Cold-blooded animals and gymnosperms are substance instances of such a property. And such a property is a property of the

property of <u>not</u> being year-round adapted. <u>Not</u> being year-round functional dictates not being year-round adapted.

So there is both affirmation and denial of adaptedness here, as in the observations by Dobzhansky.

Summarizing this section on properties in various groups, some common properties are shared as follows:

1. Overwintering,
2. Winter adaptedness,
3. Spring-summer growth,
4. Summer adaptedness.

Their substance instances are in:

Angiosperms (flowering plants),

Insects,

Hibernating mammals,

Birds.

Further properties are:

5. Year-round functionality,

6. Year-round adaptedness,

7. Year-round non-functionality,

8. Year-round non-adaptedness.

Their substance instances are in:

Non hibernating mammals (5. and 6.),

Cold-blooded vertebrates and gymnosperms (7. and 8.).

The Breakdown of the Identity of Indiscernables

One may wonder why a theory of the structure of a particular organism or species has been followed, in which properties, tie, and individuator are required – this is the substrate attribute theory. Instead a theory having only properties might have been followed – this is the bundle theory. At first the tie seemed to be required to glue the abstract, incorporeal attributes to the physical attributes. But now the bare substrate, the propertyless bearer of properties – the individuator – seems to be required in order to steer the identity of indiscernables away from lapsing into ambiguity. The next three steps portray this ambiguity.

1) If the bundle theory is espoused, then it is not only true but necessarily true in the sense that every property of the bundle is an essential constituent in the structure of a thing. 2) And if it is impossible for two things to share all their properties because complete qualitative indiscernability entails numerical identity (Loux, 2003, pp. 112-113), then two things that conceivably do share their properties are not two but are one, are numerically identical. 3) But being one can be falsified by the logical possibility of two things that are exactly alike (Armstrong, 1989, p. 67), because two things exactly alike in empirically pure properties might differ by each having an impure property the other does not have, such as being identical with itself or being in a certain location (Loux, 2003, pp. 114-116). This ambiguous 2-1, 1-2 vacillation ought to be avoided.

Thus an individuator would seem to be required, and the identity of indiscernables can then be used in a further and exhaustive break-down to derive ontologically the taxonomy of species.

As our exposition has progressed the instances of properties have clearly come to be whole organisms. Instances of this sort, it was said, are substance instances. But the overwinteringness in one single animal (or one single plant stage) is one instance and this is a property instance – just as the redness of one rose is a property instance of the redness in all the roses of that shade of red. But there is a vital crossing point here, for the property instances when put together compose the whole animal or plant, which is the substance instance of the many properties that the animal or plant possesses and which compose the animal or plant. Furthermore, one whole organism, a collection of property instances, is a particular in a kind, a species. This is to say, this collection contains

instances of properties of the capping property of being the whole organism, the whole plant or *animal* – this capping property defining it as a member in a kind, its species.

The whole individual organism *x*, the whole plant *x*, the whole animal *x* tell us that we are not naming these entities with the linguistic name '*x*'. The whole individual organism *x* has *x* as a part of it (see Hulburt, 2003, p. 78). The origin of this issue is given in III, wherein the variable *z* is the whole of adaptedness and these are not two things but one, just one. Here the variable *x* is part of the whole organism, plant or animal. Thence the organism's *x* is in the organism when the organism is a member in a kind, a species.

So we have a member in a kind, a species. But what gets to a kind, a species? What gets to a kind or species is membership. Thus there exists organism (member); there exists membership (belonging to); there exists species (kind). Where *x* is in one organism (a tree), E means *is a member of* (*belongs to*), *A* is a species (the red spruce, for example), we have: a given tree's *x* is a member of the species, the red spruce : *x* E *A*. If there were no abstract existence of membership linkage between organism and species, the world would be a heterogeneous litter of this and that. But what we see is the very opposite. We see a woodland of spruce trees, perhaps, each tree a member belonging abstractly to its same single species.

The distinction between property and member is gotten, linguistically, by the difference between adjective and noun. Thus, one tree is photosynthetic (adjective); in a woodland one tree is a red spruce (noun) – one tree is a member of the kind red spruce:

'is a' is short for 'is a member of' (Langer, 1967, pp. 113-114). And so there are species, not just the red spruce, but the white spruce, and so many, many others. And the break-down of the identity of indiscernables to give these can be extended exhaustively to give some of the great classes of animals and plants. We now trace briefly this break-down for land vertebrates.

First we return to the squirrels mentioned earlier. Thus there could be two squirrels exactly alike, that share the same properties. There could be many qualitatively indiscernible but numerically different squirrels. Let us suppose this possibility. From this possibility comes the actual break-down in the complete sharing of properties to produce the gray squirrel and the fox squirrel, where the gray squirrel has two upper

premolar teeth and the fox squirrel has one upper premolar tooth (Pratt, 1935). Squirrels share with other families in the order of rodents the property of chisel-like incisor teeth and the property of no canines. But they do not share these properties with other mammals, so there is a small break-down in sharing – but only a small break-down because rodents share with other mammals the properties of separation of the urogenital system from the rectal and the presence of a diaphragm (Kingsley, 1917, p. 140, p. 59), the properties of single aorta to the left (Kingsley, 1917, pp. 296-301; Weichert, 1970, pp. 563-568; Walter and Sayles, 1949, pp. 367-368), of mammary glands, live birth, fur, and external ears. But there is break-down with birds, which do not share these with mammals. The major shared properties of mammals and birds are warm-bloodedness, having a completely four-part heart and having a single aorta, though to the right in birds (references just given). So we have two large classes of vertebrates with Cenozoic

histories. The present day remnants of Paleozoic and Mesozoic land vertebrates, reptiles and amphibia, share cold-bloodedness and paired aortic arches, 3 to 4 pairs in amphibia and one pair in reptiles (references just given). But they don't share these with birds and mammals. The only major property they all share is having four appendages (except snakes, a few lizards, and caecilians and amphisbaenians (Carroll, 1988, pp. 182-183, 233-234)).

In the case of flowering plants (angiosperms) we will just mention some features in the pattern of diversity. The properties of having 2-5 carpals, having often 5 stamens, having predominantly 4-5 petals, having about 5 sepals are shared extensively, whether the petals are separate (the Archichlamideae) or fused into corolla tube (the

Metachlamyseae). The break-down of this sharing is minor when some families have many stamens or carpals (pistils), is marked when some families have loss of petals and sepals (oaks and beeches) and when some families have compound flowers (daisies, asters, and dandelions). Still, all these families share non-parallel-veined leaves and two cotyledons and do not share these with families sharing parallel-veined leaves and one cotyledon and three petals and three sepals (Johnson, 1931).

The gymnosperms are very similar in their evergreen needles, their cones – and only a small diversification of their basic structure would provide their observed diversity.

And so it is apparent how the taxonomic diversity into some of the great classes reduces the sharing of morphological corporeal properties. But, as pointed out earlier, the sharing of abstract incorporeal properties or universals is prevalent throughout these great

classes. These incorporeal properties include overwintering and winter adaptedness, spring-summer growth and summer adaptedness, year-round functionality and year-round adaptedness, year-round non-functionality and year-round non-adaptedness.

This concludes a study of adaptation analyzed by applying metaphysical philosophy. Other studies of adaptation analyzed by applying predicate and axiomatic logic and set theory are by the author (Hulburt, 1996, 1998, 2001, 2002, 2004a, 2004b). These studies are all analytical and have an explicit data base (much more so than this study). These studies are analytical in this sense. Are there any other analytical studies in any sense?

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