4. LEVELS IN DESCRIPTION AND EXPLANATION

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ABSTRACT. Various authors insist that some body of natural phenomena are legitimately describable or explainable only on one level of description, and would disqualify any description not confined to that level. None offers an acceptable definition explicitly. I extract such a definition I find implicit in the work of two such authors, J.J. Gibson and Hubert Dreyfus, and modify the result to render it more defensible philosophically. I also criticize the definition Shaw and Turvey offer, demonstrate some applications of my definition, and try to forestall certain misunderstandings of those presuppositions and that definition.

J.J. Gibson and Hubert Dreyfus, among others, have claimed that there are 'levels' in nature, such that different 'levels' of explanation or description are legitimate for—and only for—corresponding natural levels. In Gibson's case and in Dreyfus', as in others, there is interest in explanation or description at one such level, of one level of nature: Gibson's last treatise was an attempt at explaining the natural 'ecological' level through development of a theory of perceiver and environment in the corresponding level of explanation (private communication), and he asserted repeatedly that 'ecological' level of explanation was not to be confused with any explanatory level usually employed in physics. Dreyfus, in his famous attack on cognitive science, wanted to establish that there was not a 'psychological' level of explanation or description corresponding to any natural level between those described/explained in the phenomenological and neurological levels.

Gibson and Dreyfus are far different in their purposes an emphases, and the theories and descriptions they offer differ in ontological emphasis. Yet it should be obvious to anyone who understands them both that Gibson's ecological level of explanation and Dreyfus' phenomenological level are the same: they apply to and are grouped in the same level of nature.

There are certainly those who would do almost anything to avoid admitting that Gibson's and Dreyfus' accounts are in the same explanatory level. After all, one way to avoid criticism (especially since Kuhn) is to claim that seemingly-rival accounts are incommensurate: the rival cannot really criticize one's pet theory because it isn't quite in the same language or about quite the same things. This tactic is easy to employ if every theory carries with it its own (unique) "level". (Of course, to change any detail of one's theory is then also to change its level, so...
there is on such a view no way to tell whether any change is an improvement.) It is more honest—to Kuhn and to levels—to admit that several different theories can belong to one level.

Surely there is a difference between a theory and a level of description and explanation ('theory' here used loosely to include explanations and mere descriptions). A descriptive/explanatory level countenances all terms that refer to items proper to the corresponding natural level and descriptions expressing interrelationships appropriate to items of that natural level. A theory need not, and usually does not, pretend to account for all such possible items and relations. Indeed, in formulating a theory one tries to avoid expressions which falsely express relations which would be appropriate but which do not obtain. Most theories are concerned with some domain within such a level—many is the theory which simply assumes "standard conditions" of temperature, pressure, etc. Gibson was aware of the role of mental activity in perception, but carefully avoided making it an important part of his perceptual theory, in order to emphasize the information available in the environment. ("Once a donkey gets its nose through the door, you'll soon have the whole animal in the house"—or words to that effect (private communication). Once you let the usual psychologist or philosopher say anything about the mind, you'll soon hear nothing but talk about the mind, and once again the very important facts about the environment will get ignored.)

Too, our linguistic usage reflects a difference between theory and level. It is one thing to say that two theories disagree, and quite another to say that one is illegitimate or meaningless in the other's explanatory level. To say that two theories disagree is to say that they are about the same subject, and that at least one asserts falsehoods of which the other is not guilty: it is to make a claim about truth and falsehood of explanations, descriptions, ontological claims, and hence it is to assume that the claims are meaningful. To say, on the other hand, that one of the theories is illegitimate because it is not formulated in the appropriate explanatory level, is to assert that it is without meaning in that level—and hence that its 'assertions' cannot be true nor false.

There is nothing to require that there never be more than one theory appropriate to one descriptive/explanatory level, then: there can be conflicting theories, and theories which concentrate on different regions of the natural level with which a given explanatory level is concerned. We can say that many—probably all—assert significant falsehood, but, as shown, this is entirely different from claiming that they are not meaningful at all. This is what we have in the case of Gibson and Dreyfus, and this affords us an excellent opportunity to sort out the concept of a level of description or explanation, which they share, from the very different, specific explanations and descriptions they offer in that level.

In what follows I shall try taking advantage of this opportunity by extracting a definition of 'level of description/explanation' from their work, and then improving on it through some criticism. I shall then apply this definition in sketching how one might go about showing that Dreyfus' phenomenological descriptions do belong to the same explanatory level as Gibson's ecological psychology.
Gibson and Dreyfus are not the only writers concerned with explanatory/descriptive levels, of course. The neo-Gibsonians Shaw and Turvey even offer a definition of 'level', though as I shall argue (in Section 5), they unfairly import their own favored sort of theory into this definition. (This article's original was inspired, some years ago, by a conversation in which Gibson expressed reservations about the Shaw-Turvey definition and queried whether there was some more neutral definition anywhere in the philosophical literature [private communication].) Too, Simon and Pattee discuss 'levels' in their treatment of complex, hierarchically-organized systems, though their use of 'levels' does not correspond to levels of nature or description (as I shall indicate in Section 7). Indeed, different senses of 'level' abound. Russell used the term in his type theory in a way not quite commensurate with the Gibson-Dreyfus usage, Craik and Lockhart use the term 'levels of processing', and the list goes on. But translating what follows into Russell's theories of type and description would be procrustean and unilluminating. For Craik and Lockhart, a 'level' is sometimes really a stage of processing, and many such stages may occur on the same level, in the Gibson-Dreyfus sense of 'level'. To discuss 'levels of processing' is to discuss theories appropriate to one or another level. I hope to be allowed to neglect discussion of other senses of 'level', to concentrate on illumination of 'levels' as Dreyfus and Gibson use the term.

I. LEVEL OF NATURE

In this article I try to define 'level' in the Gibson-Dreyfus sense and to indicate its background and some of its applications. The reader cannot understand descriptive/explanatory 'level' in this sense unless she recognizes that it is inextricably intertwined with and dependent upon the existence and nature of natural levels. I shall not try to prove that there are such levels in nature. But it is important to know what these levels are like in the Dreyfus-Gibson view, and to see how they underline the nature of—and the very possibility of—levels of description and explanation.

For Dreyfus and Gibson, then, nature is itself divisible into natural levels. The function of any family of descriptions appropriate to some descriptive level is to describe an interactive (usually causal) network in nature. A natural interactive network spanning any one level of nature encompasses a range of items virtually nonoverlapping with that of any other level of nature.

A natural level is closed (to the degree it is) in that the items of one level interact only with other items of the same level. It is complete in that any item of a given level (i.e., encompassed by a given network) is affectable by other items of that same level (i.e., in that same network). It is connected in that this network cannot be decomposed into two subnetworks, each of which itself has its range of items not overlapping with the other's, and each of which (subnetworks) also is 'closed' and 'complete'.

There is leakage—there is some interlevel interaction and there are some effects occurring on other levels—but it is important that these can be disregarded as negligible. Such a network is 'statistically closed', in Pattee's sense: the natural level's network provides 'a set of collective constraints that in some way limits the detailed behavior of
the elements that make up" a collection which, as such, is statistically closed.

Each of these characteristics of a natural level—distinct ontology, closedness, completeness, and connectedness—is mirrored in a corresponding quality of descriptive/explanatory levels. Indeed, it is the natural qualities upon which the corresponding qualities of a descriptive/explanatory level are based, and which guarantee the latter's usefulness and reliability. For example, a descriptive level is 'closed' in that any description using terms specific to that level and none specific to another level, describes something referable to only by another term specific to that level: the terms correspond to the natural level's items, the description corresponds to an interactive relationship among those items, and hence the closedness of the natural level guarantees that closedness of its corresponding descriptive level. To say that any description formulated from one descriptive level's terminomology belongs to that level is not an analytical statement; it relies on the descriptive level's correspondence to a level of nature.

Gibson and Dreyfus ignore leakage between natural levels. A level of nature may be only statistically closed (and complete), but a level of description is treated as strictly closed and complete. Natural levels may be virtually nonoverlapping; but descriptive levels are treated as absolutely nonoverlapping. Each natural level has its appropriate descriptive level. Hence, on the Gibson-Dreyfus view an activity or event described at one level cannot be said to be caused or affected by events described at another level. This is why Dreyfus asserts, against Neisser, "Light waves falling on the retina eventually lead to physical and chemical processes in the brain, but in this sequential sense, the light rays and neural processing can never eventually lead to seeing. Seeing is not a chemical process; thus it is not a final step in a series of such processes." And Gibson asserts that the causal networks described at different levels are even different in kind. The nature of interaction at one level can differ from, even be incommensurable with, that of another. Hence, e.g., quantum theory is thought appropriate to one level of explanation in physics, but not to another. And hence, e.g., intentional explanations may be appropriate to the level of mental life, but not to that of neurological activity.

A. WE COULD BE WRONG ABOUT LEVELS

Note that it is a matter of theory that there are levels of nature, and that some specific collection of items belong to some one level. Either of these claims could prove false. Certainly one of the identity theorists' claims (most notoriously Smart) was that the mental realm is a region belonging to a natural level also described by physics. Whether right or wrong, it was a theoretical claim for the existence of a single level where others thought there to be two. And as I have pointed out, natural levels, if more than one exist, may not be absolutely closed: it is conceivable that a chemical reaction, described as such, may fit into a pattern of constant conjunction in space and time with some mental event, described as such—even though we could not legitimately say so within any one level of explanation—or that a nuclear reaction, described as such, might account for the physiological deterioration of some biological organ, described as such—though again, one is not allowed to say so in any one explanatory level. (How is one allowed to say
it at all, then? See Section I.C.) It would appear that there is leakage. Coherent discussion of whether this leakage is negligible or significant is possible, where one transcends levels of description. The more significant the leakage, the less defensible is the belief in distinct natural levels. That there are natural levels and that one knows what they are, are at least in part empirical matters not resolvable solely though conceptual analysis.

B. NATURE IS HIERARCHICAL

Nature itself is hierarchical throughout, in some ways in Simon's sense: there are systems consisting of interaction among subsystems, where each subsystem consists of interactions among its sub-subsystems, etc.\(^4\), and such subsystems may be 'nearly decomposable'. I.e., components of one sub . . . system interact almost exclusively with other components of the same sub . . . system, and only to a negligible degree with components of other sub . . . systems (even of the same hierarchical layer). An hierarchy is a "system that is composed of interrelated subsystems, each of the latter being, in turn, hierarchic in structure until we reach some lowest level of elementary subsystems."\(^5\) This imposes a partial ordering: a system is on an hierarchical level 'above' that of its subsystems, and 'below' that of a system of which it is itself a subsystem.

But a natural level, as understood by Dreyfus and Gibson, cannot be simply a level of organization of natural systems, since both Gibson and Dreyfus recognize that there are hierarchies within the interactive network to be explained on the (single) ecological or phenomenological level. For Gibson, "it is important to realize that smaller units are nested within larger units. There are events within events, as there are forms within forms, up to the yearly shift of the path of the sun . . . and down to the breaking of a twig"\(^6\)--all on the ecological level. For Dreyfus (following Todes), "the world is experienced as fields within fields. Bits or aspects of objects are . . . experience . . . as nested in a series of contexts."\(^7\) Obviously in this single natural level to be described there are superordinate systems decomposable into subordinate systems, and hence different strata of organization within the purview of a single descriptive level.

In general there can be a system of many organizational strata within a single interactive network, and hence on the same natural level, even if the system is 'nearly decomposable' in Simon's sense. For even if items in one stratum interact, as components of the system, only with fellow occupants of that stratum, nevertheless items of different strata may interact, not as that system's components, with other items in the natural level's realm. Consider Simon's favorite example of a watch: At one stratum there are individual gears, springs, jewels, etc. On another stratum there are gear assemblies, etc., composed of gears, springs, jewels, etc. On another stratum there is the watch as a whole. One gear assembly, as such, is understood as interacting with other gear assemblies as such, not with an individual gear and not with the watch as a whole: the watch is 'nearly decomposable'. But one and the same rock can crush equally and in the same sense one gear, one assembly of gears, and one watch.
This means that we may distinguish between what I shall call analysis and what I shall call reduction: on the Dreyfus-Gibson view, we can legitimately analyze some item (as a 'nearly decomposable system') in terms of 'lower organizational stratum' components embedded in and functioning as components of it, within a single descriptive/explanatory level, even though Gibson and Dreyfus hold it to be a mistake to posit causal relations among entities described or referred to on different descriptive levels, and even where they would object to anyone trying to reduce an item described at one level to some interrelated subelements described at another level. (Reduction can involve more than one descriptive/explanatory level. Where it is confined to a single level, i.e., where it is analysis, it is permissible.) Hence Gibson can analyze an 'affordance' of some object in terms of size relations between object and organism for which it has affordance, interrelationships of that object's surfaces, etc. And hence Dreyfus can entertain the reductionist hypothesis that seeing might be the whole chain of neurophysiological events of retinal excitation and resultant neural activity, and still deny that seeing and these events are causally interrelated.

C. The Nature of Translevel Claims

Of course, Dreyfus does not assert the above reductionist claim. What he writes is, "either seeing is the whole chain or something totally different from the chain or any link in it." I suggest that if one can neurologically specify some type of item in the interactive network described or referred to at the phenomenological level, then the neurophysiological and phenomenological levels of description are one. That is, that sort of item then must be admitted to belong to both natural levels' interactive networks, so they must be one. But so far no one seems to have succeeded in this reduction, and I doubt that Dreyfus thinks that anyone ever can.

Still, how can Dreyfus say that seeing is not a neurochemical process? After all, this too is a translevel statement. (Were it meant as belonging to one level, it would be meaningless (with respect to that level). But here Dreyfus clearly means to say something about things he knows to belong to different natural levels, and hence to be making a translevel statement). Is he claiming that translevel statements are false, or that they are meaningless?

I suspect that Dreyfus would rather hold translevel statements meaningless. "Seeing is a chemical process" is meaningless." But such a position is hard to defend in light of the empirical nature of claims about levels: in principle, we could be wrong. What we thought to be two distinct levels could turn out to be one. Hence what had counted as meaningless now turns out to have a truth-value. Dreyfus could then say that he was wrong about the sentence being meaningless in the first place. But the only reason he thought it meaningless was that he did not believe that the sorts of item the sentence would relate were of the sorts that could interact with each other.

It is much more straightforward to say, not "Seeing is a neurochemical process" is meaningless," but "Seeing is a neurochemical process" is false." I recommend this second alternative. On this (recommended) view, to hold that there are levels of description to correspond to (the) levels of nature (we think there to be) is to partition the family of
all possible descriptions, first into intralevel and translevel descriptions, and then the intralevel further into the closed, complete, connected, and mutually exclusive families of descriptions appropriate to their respective levels of nature. It is a matter of theory that there are those levels of nature. It is a consequence of this theory that translevel descriptions are false, derived from the working (and simplifying) hypothesis that there is no interaction between levels.

("But we know that there is some interlevel interaction!" Well, it appears that there is. Perhaps as theories advance we will explain this away. For now we tolerate this as an anomaly.)

(I have been known to twit the less perceptive critic by saying such things as "Retinal excitation does not cause seeing, but I can't say so". The more perceptive critic grasps what the less perceptive critic does not, that here I use a double meaning: I can assert, as a translevel statement, that retinal excitation, which occurs in one natural level, does not cause seeing, since seeing occurs in a different natural level; but I can also assert that the same statement, taken as belonging to a single explanatory level, would be meaningless.)

II. LEVEL OF DESCRIPTION

A level of description is a family of descriptions that has its own terminology, and is what I call 'closed', 'complete', and 'connected' under description. The first three of these requirements can be extracted from Gibson's and Dreyfus' work. The fourth--connectedness--I add to render the definition I extract from their work defensible.

A. A LEVEL HAS ITS OWN TERMINOLOGY

Dreyfus and Gibson clearly recognize that a level has its own terminology. Gibson's final work offers an Appendix devoted to defining the special terms for his ecological level of psychology, and Gibson is careful everywhere to choose the right terms to describe the content of his theory and to differentiate them from what he considers the wrong terms--wrong usually because of their meanings at other levels. Dreyfus assumes in several passages that certain terms can be employed only on certain levels. E.g., against a psychological description of the brain as an energy-transforming organ he writes, "this psychological description, excluding as it does all psychological terms, is in no way a psychological explanation. On this level one would not be justified in speaking of human agents, the mind, intentions, perceptions, memories, or even of colors and sounds, as psychologists want to do. Energy is being received and transformed and that is the whole story."

We may assume that some terms are level-neutral. But no description or explanation may contain in it terms specific to two different levels.
B. A LEVEL IS 'CLOSED' UNDER DESCRIPTION

A level of description is closed under description.

In algebra, the even integers are closed under multiplication, in that the result of multiplying together any two even integers is another even integer. Analogously (as noted in Section 1), a descriptive level is closed in that any description using terms specific to that level and none specific to another level, describes something referable-to only by another term specific to that level. That is why any description formulated from one level's terminology belongs to that level (that family of descriptions).

Dreyfus recognizes closure implicitly in the above passage: the physiological descriptions to which he refers use only neurophysiological terminology, and hence can describe only neurophysiological items, not such items named in the phenomenological level as intentions, perceptions, etc. Gibson held that "the basic concepts of space, time, matter, and energy do not lead naturally to the organism-environment concept or to the concept of a species and its habitat," which I take to be an implicit evocation of the concept of closure: use of those concepts in description and explanation only applies to other items described in their level (closure), not to such things as organisms, which are described on a different level.

My concept of closure is more like the algebraic concept in the above analogy than it is like Pattee's concept of 'statistical closure', as described in Section 1. One might say that a collection of natural items interacting in a statistically closed way would constitute a level of nature that a Gibson or Dreyfus would expect to describe by means of a theory on the same descriptive/explanatory level, but that descriptive/explanatory level is itself closed in the stricter sense specified here.

C. A LEVEL IS 'COMPLETE' UNDER DESCRIPTION

A level of description is complete under description. This is really the other side of the coin from closedness: anything named or referred to by a term specific to a given level can be described only by a description containing terms specific to that level and none specific to other levels.

This aspect of levels is harder to pinpoint in Gibson and Dreyfus, but there are hints. For Gibson, "physiological optics, concerned with receptors and stimulus energy, is adequate to explain... pupillary adjustment. Ecological optics... is not required." The different levels of description and explanation correspond to different levels of activity; thus pupillary adjustment, designated by a term from the physiological level, is described and explained on that level. The phenomenological level's completeness for Dreyfus seems implicit in the following: in describing the field of experience he writes, "Any object which we experience must appear in terms of our dominant interest at that moment, and as attainable by some variant of the activity which generated the field." Thus whatever item we name as belonging to our experience must be describable by means of the terms we use in referring to or describing the interests and activities which concern the experience.
D. A LEVEL'S DESCRIPTIONS ARE 'CONNECTED'

A descriptive level must be connected. That is, the family of descriptions appropriate to a level cannot be decomposed into two mutually exclusive subfamilies such that no sort of item referred to or described by a member of one subfamily can be referred to or described by a member of the other subfamily (in a true statement). (This is a preliminary definition only. See Section 4.)

I find no use of 'connectedness' in Gibson's or Dreyfus' work. In Section 4, however, I give reason to think some such addition necessary to defend the sort of concept of 'descriptive/explanatory level' Gibson and Dreyfus want.

III. LEVEL OF EXPLANATION

An explanation is a kind of description: the sort that describes interactions among items (events, objects, activities, etc.) referred to or described on that level.

I have distinguished between 'description' and 'explanation' because Gibson claims to offer explanations by means of his theory on the ecological level, while Dreyfus claims to offer rather descriptions on his phenomenological level. But note that for Dreyfus an explanation is "a complete description". He claims to offer a collection of descriptions which is incomplete. He does not want the same kind of explanation AI people want, but he does recognize that it is possible (among other possibilities) "to propose a different sort of explanation," from which the incomplete descriptions he offers do not differ in kind27.

Hence to call a level 'descriptive' or 'explanatory' is a matter of emphasis. A level of explanation is a family of descriptions, some of which explain.

IV. THE 'CONNECTEDNESS' REQUIREMENT

Suppose some family of descriptions has its own special terminology, and is 'closed' and 'complete' (in the senses I have given these terms), but that the family can be divided into two subfamilies of descriptions, each of these 'closed' and 'complete', and using one part of the terminology of which the other makes no use, using instead the rest of the terminology, of which the first makes no use. Each subfamily, it would seem, describes an interactive network which does not overlap with the interactive network described by the other. The whole family of descriptions then should not count as a 'level of description'. It describes two levels of nature, not one--each of these natural levels described by one of the subfamilies of descriptions. (Of course we might think a family of descriptions to decompose in this way because we are ignorant of some of its members--there are some interactive relationships we did not know to exist. For this reason we might think there to be two levels where instead there is only one--because we did not know the two apparently different realms to be connected.)
More importantly, a closed, complete family of descriptions is likely to contain some descriptions which are false. (It is one purpose of theories, after all, to differentiate some true descriptions or explanations from a realm of possible descriptions and explanations, not all of which (possible) descriptions and explanations need be true.) What, then, if the (sub)families of true descriptions decompose into two closed, complete subfamilies, each with its own terminology? That is, what if what was thought to be a single interactive network is really two mutually exclusive interactive networks: We unwittingly included some translevel statements into a combination of two levels of description. Those descriptions purporting to relate items of the two distinct natural levels are false because (though we did not know it) they are translevel. The remainder, proper to one or the other of the two descriptive levels, may be true. At least the working hypothesis of levels in nature does not imply their falseness. This remainder divide into two levels of descriptions.

If 'connectedness' is required, as I recommend, for a family of descriptions to constitute a level, then no level of description can be decomposed into two levels of description.

In addition, the 'connectedness' requirement provides a means to show that what were thought to be two descriptive/explanatory levels are one: one shows that one family of descriptions does include a description of or reference to some type of item also referred to or described by a member of the other family. (Equivalently, one shows that there is some true description containing references both to some sort of item in the range of one (sub)family and to some sort of item in the range of the other (sub)family.)

V. THE PSYCHOLOGICAL LEVEL

Now I shall illustrate the definitions I have offered. I shall apply them to outline how one might show that Gibson's 'ecological level' and Dreyfus' 'phenomenological level' are the same—are what I shall call 'the psychological level'—and to show in so doing one way to argue that some sort of item not posited by a theory or set of descriptions is nevertheless appropriate to that theory's or set of descriptions' level. (The latter is the real point of the exercise. The former is just a way of doing the latter. Anyone who has read this far without understanding that Gibson's and Dreyfus' levels are the same should give up.)

A. GIBSON AND DREYFUS ARE ON THE SAME LEVEL

There are people who would say almost anything rather than admit that Gibson's and Dreyfus' descriptive levels are the same. (Though Dreyfus did once volunteer to me, in informal conversation, that he thought his work to be in the same descriptive level with Gibson's.) Surely their work emphasizes different parts and aspects of this shared level. Certainly they choose different descriptions to apply to the same sorts of item, if their ranges do overlap. But as noted, neither claims to have a theory which exhausts all of the true statements of a level of description. I have shown that theories can be different, while belonging to the same level, and to say the preceding is only to say that Gibson's and Dreyfus' theories are different.
Now, Dreyfus asserts, "the meaningful objects embedded in their context of references among which we live . . . they are the world itself." Plans and fears are "built into" experience of some objects as attractive and others as to be avoided. The invitation qualities of items of the sort Dreyfus describes in this way are, of course, among those to which Gibson refers as 'affordances', and vice versa. Gibson's theory about them differs from the sort of description of them Dreyfus offers. But that is just to say what I said: two approaches, but, trivially, one level. So long as Gibson's ecological level is connected and Dreyfus' phenomenological is connected, the two are connected in one level—the 'psychological level'—since they overlap over (connect through) the considerable realm of affordances. (Closedness and completeness take care of themselves in an obvious way. Gibsonian and Dreyfusian terminology merge into a single terminology—neither author claimed to have exhaustively employed the terminology for this level anyway.)

B. ESTABLISHING AN ITEM AS APPROPRIATE TO A LEVEL

Dreyfus' descriptions do not countenance the sort of item referred to by Gibson's term, 'visual information'—indeed, Dreyfus would not hold that such things exist (at the phenomenological level). Nevertheless one can argue that a term not countenanced by a theory is appropriate to that theory's level. (The same goes for an array of descriptions.)

'Visual information' is alien to Dreyfus' approach. For Dreyfus, only the types of entity of which one may be conscious, can be described or explained phenomenologically. Hence, e.g., computer-model explanations of artificial intelligence are illegitimate on the phenomenological level because "there is no awareness" on the human's part "of following instructions or rules; there is no place for a psychological explanation" in terms of following instructions or rules. Hence too, e.g., linguistic performance, like visual recognition or a motor skill, must be described as regular without being rule-governed because "the native speaker . . . is not aware of having generated multiple semantic ambiguities which he then resolved by appeal to facts any more than he is aware of having picked out complex patterns by their traits or of having gone through the calculations necessary to describe the way he brings his hand to a certain point in objective space."29

Dreyfus' account, in common with Gibson's theory, is direct and naive realist. For each, then, (among other consequences) perception is of items (objects, events, etc.) which exist (occur, etc.) in nature independently of anyone's perceiving them (as such). Terminology referring to perceptual experience and its natural objects is proper to Dreyfus' phenomenological level. One is not aware of Gibson's environmentally available visual information (it is a theoretical construct), but this information is explainable entirely in terms of terminology for perceptual experience and its objects, and hence in terms of terminology appropriate to Dreyfus' phenomenological level.29

I take the terms of geometry to be level-neutral.

Now, visual information consists of configurations of projections of light reflected (or radiated) from surfaces to a viewpoint, together with transformations on this array over time. (Gibson has described it in this way on occasion, and on other occasions in other ways. But this is ir-
relevant. The important points are that this description does apply to visual information, and that this description is legitimate on the phenomenological level.) In Gibson's theory we are visually aware of an object in resonating to the visual information that specifies it. We are not aware of the information as we use it thus, though we may attend to reflected light as such.

On the phenomenological level one refers to seeing an object and to an object thus seen.

I think Dreyfus would agree that one can be aware of reflected light.

Under what conditions is an object seen? Among others there must be a projection of light from the object's surface(s) to (at least one of) one's eyes, and others from 'background' surfaces, in contrast to the light reflected from the seen object. (The contrast is crucial. That is why sometimes a polar bear is invisible against a background of snow. And that is why a 'nonreflecting' object can be seen against a reflecting background—no light is, as such, in contrast with some light.)

Under what conditions is an object seen to move? The position of the object's projection changes among those of the background surfaces.

More detail is possible, of course. I think it clear, in principle, that the arrays of surface projections of light and transformations of such arrays which (according to Gibson) constitute visual information specifying various sorts of object, event, etc., can be picked out phenomenologically in the way sketched above, each sort of information as corresponding to the sort of item it specifies. This can be done on the phenomenological level, even though the phenomenological descriptions Dreyfus would choose to offer would not explain these transformations on configurations of reflected light as visual information in the way Gibson theorizes. (If the phenomenological level is 'closed' then, since phenomenological descriptions refer to the sort of item called 'visual information', that term belongs to the phenomenological level.) Moreover, if visual information exists, it interacts with seeing and seen objects (etc.). In short, though Dreyfusian descriptions would not posit visual information as a type of item, that sort of item, if it exists, exists in the natural level to be described on the phenomenological (psychological) level.

(Note: I have argued that the theoretical construct 'visual information' belongs to Dreyfus' phenomenological level, not just because it relates items of a sort to which one may refer phenomenologically, but also because it can be described as a sort of item which, if it exists, interacts with phenomenologically-characterized items—on the appropriate natural level. A term appropriate to a different level might also refer to phenomenologically-characterized items as the term is used in a reductionist statement. But such a reductionist term would refer to items such that, if they existed, they would belong to a different interactive network, and could not be said to interact with items described/explained on the phenomenological level.)

In sum: Since Gibson's and Dreyfus' very different descriptions belong to the same 'psychological' level, this is the level for describing and explaining the interactive network different parts of which the two
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approaches address. This is the level for accounting for mental experience as such, the environment as it is perceivable (not as atoms, neutrons, molecules, and quarks), and whatever else shares the interactive network spanning these, e.g., visual information.

VI. SHAW AND TURVEY GO TOO FAR

I have defined a 'level of description/explanation' as a 'closed', 'complete', and 'connected' family of descriptions that has its own terminology. Each descriptive/explanatory level is devoted to a level of nature. The items (objects, events, etc.) of a single natural level interact among themselves in a single interactive network, and at most negligibly with entities of a different level (in a different interactive network).

It is a matter of theory to say that there are such levels of nature, and a matter of still more theory to assert that some specific collection of items are contained in and exhaust a single interactive network, to be described and explained on a single level. Though I have concentrated on the psychological level of description and explanation, I have tried to offer a general, minimal definition of 'level' which could be applied to all descriptive/explanatory levels. Might one, concerned primarily with one natural level, try to construct a more detailed definition of 'level' which, whether or not meant as a general definition, is especially appropriate to that natural level of primary concern? The neo-Gibsonian Shaw and Turvey have tried just that. I shall sketch some aspects of their definition—which they formulate in general terms, but mean especially for the psychological level—and tell why I disapprove of their definition.

Shaw and Turvey recognize that psychology has (or should have) its special vocabulary. Where I have noted that there are hierarchies within a level, they declare that what I have called a 'level' has an hierarchy of four 'grains', the contents of each organizing the contents of the previous in some way. Where I have stipulated that a level, as a whole, must be closed, they insist that each grain be 'closed': a closed set of 'duals', a 'dual' being "two complementary subsystems (that) act as reciprocal context of mutual constraint". Each grain is 'closed' in that for any member of a grain there is in that grain another corresponding to the first as its 'dual'. Since an item, as grain member, is supposed to interact exclusively with its dual, each grain would be closed in my sense. Too, each grain would be complete, since each member has its dual in that grain. Hence the Shaw-Turvey definition is a special case of my definition. (The relations of the four levels guarantee connectedness.)

I shall neglect the question, "why four grains?" to concentrate on the question, "why duals?"—for the former is a technical matter, and the latter concerns the issue of definition-neutrality.

Why duals? In essence, because this requirement promotes direct realism and a balanced treatment of organism and environment. On the neo-Gibsonian view, the environment has affordances: it affords various uses to the organism, which has effectivities or abilities to make use of these affordances. Indeed, there are dual isomorphisms. (My) e.g., a cliff affords both falling-from and looking-as-though-fallable-from, to which correspond the effectivities for falling from a cliff and for seeing
that one could fall from it. An organism can be understood as a structure of effectivities, and its environment the corresponding structure of affordances. An 'ecosystem' then is a related structure consisting of such dual affordance and effectivity structures. A fourth grain of analysis accounts for the presence of some such ecosystems and the absence of others. Hence at any grain, to account for anything of interest, e.g., an effectivity, one has also to account for its dual, e.g., an affordance, which directly interacts with it in a context of mutual constraint.

Now, if a level—e.g., the psychological level—is to be defined in this way, then anything described/explained must be described/explained as having its (also described/explained) dual, and there is no room for such mediators as propositions, ideas, images, concepts (Shaw's and Turvey's list). This is a desired result, say Shaw and Turvey, mandated by a commitment to realism and opposition to dualism and organocentric views. A person's seeing an object to approach her is a direct interaction between the visual information provided by this event (transformations in the array of light reflected from the moving object and its surroundings) and the person's visual effectivity for registering this information: there is no mediating retinal or visual image, no sequence of information processing stages leading to an act of seeing. (Borrowing from Dreyfus, Shaw and Turvey could suggest, perhaps the information processing stages are the effectivity.) That person's catching the moving object in her hand is a corresponding interaction between the moving object (which affords being caught in this way) and the person's effectivity for reaching out to catch such an object. There is no mental model constructed and then read off or periodically tested against reality.

There is much to be said for such a direct (and naive) realistic approach toward explaining cognition.

But there is no guarantee that every time we, in our research, discover or recognize a new kind of item, that we will be able to find an exact dual for it in the potential user, and vice versa. Indeed, ordinary experience offers this problem. A pair of pliers, for instance, has several affordances: one can use it to pull a nail, turn a pipe, pinch two surfaces together, or to serve as a pendulum bob. Presumably one has a distinct effectivity for each of these. Yet other sorts of object also provide one or another of these affordances, to which presumably the same effectivities correspond. I suggest that we can find it more efficient to say that there are pliers, wrenches, claws, and deadweights than that there are the above-listed effectivities, even if we cannot find an exact dual, a plier-using effectivity, in the organism for the pair of pliers in the environment.

Worse, there is a difference between saying that one's theories are conceptually purer or more comprehensive or veridical and saying that the rival theory cannot be considered at all because it is illegitimate to the correct explanatory level, or not about the same subject matter as one's own.

Suppose some theory asserted that using a pair of pliers required a triad: the pliers, which afford surface pinching, a mental model of pliers, and an effectivity which checks what one sees and feels against the model, updating the model as one goes and performing further plier operations according to the model. If the Shaw-Turvey insistence on duals
is not trivial it must rule out triads such as this. (Indeed, they intend it to, as noted earlier.) If we accept their definition of 'level' we will not test this theory through observation, experiment, and constructing working models of plier pinching. We will rule out the theory as illegitimate at the psychological level, as inherently false (because of our working hypothesis) or as not about psychological phenomena as such.

But unlike Fodor's energy transformations leading to sight, this theory seems not to mix levels. It is not appropriate to another level, referring as it does to wrench-affordances and human effectivities. It does not seem incoherent—we have a good idea how to test and model such a theory. If the theoretical construct, 'mental model of pliers', turns out to confer no explanatory advantage to the theory incorporating it, then we can say that the theory is wrong about how we use pliers.

If direct (and naive) realism is the best approach to psychology, it is because that sort of theory explain psychological phenomena better than do other sorts of theory. To say that ideas, concepts, mental models do not exist, is to say that we can explain psychology better without referring to such than by referring to them. Once it is clear that a theory is (exclusively) about the things that belong to the natural level in which we are interested, it is unfair to refuse to listen to it simply because its approach differs from ours. Surely a realist must understand that nature is as it is, even if we insist that it is otherwise.

VII. 'MULTI-LEVEL' EXPLANATIONS AND REDUCTION

As noted earlier, it is a working hypothesis of those who believe in single-level descriptions and explanations that there is no interaction between natural levels (or at least, that apparent translevel interaction can be ignored). One does not directly prove or disprove such a hypothesis (any more than one proves or disproves determinism; one simply adheres to it so long as the enterprise it governs progresses and—as has been to some extent with determinism—abandons it when the governed enterprise ceases to progress). However, I shall discuss several sorts of misunderstanding which may seem to undermine this hypothesis.

A. 'MULTI-GRAIN' DESCRIPTION

Pattee holds that "alternative levels of description" are needed to render complex systems comprehensible—for example, in computer programming. On this view we need one level to describe each available or possible component of a system, another level to describe the choice of which of those available/possible components is to be used. Those who hold to a view like this may be inclined to reject the Gibson-Dreyfus concept of single-level description out of hand. They would be wrong to do so for this reason.

Pattee (like Simon) is not interested in whole interactive networks. He is interested in hierarchically organized structures, as such: a watch as a system composed of gear assemblies, an organism composed of organs in turn composed of cells, etc. Moreover, he totally ignores levels of nature. His 'structural levels' are what I have called 'organizational strata'. Since he ignores natural levels, he believes himself free to char-
acterize a single system across several levels of nature. Hence he lists
as organization levels (his 'structural levels') for one possible sort of
system "particles, atoms, molecules, cells, organisms, etc.", each with its
corresponding "levels of description".44

Now remember that several organization strata/structural levels
can belong to a single level of nature. Pattee believes alternative "levels
of description" necessary because he believes alternative organization
strata needed in nature for design and management of very complex
systems. In a complex, hierarchically-organized system, at one stratum
are several available subsystems. Overseeing them--hence at a higher
stratum--is a subsystem which chooses among, activates, coordinates
these lower-level systems. To offer a very simple example (of my own): a
person wants to scratch her head. Available at one stratum are her left
hand and arm, right hand and arm, and spinal column and neck. At a
higher stratum is a subsystem that chooses among these, resulting in
her scratching left-handed or right-handed or learning back to scratch
the head on some other object. In this case, to say that "alternative
levels of description" are needed to describe both the options and the
choice, really is only to mean that one has to describe some of the con­tents of two different strata of organization. So long as these strata
belong to the same natural level, there is no reason to deny that they
can be described on the same descriptive level.

("But don't you need two languages--one an indeterministic lan­
guage of possibilities, another deterministic language of dynamics?" What
you say here is that you want two kinds of theory on that--one--level:
one an indeterministic theory, one a deterministic theory. No one yet has
captured all that can be said on any one level in a single theory.)

B. 'MULTI-LEVEL' DESCRIPTION

But what if the complex, hierarchical system of interest transcends
natural levels? Isn't Pattee's example of a computer just such a system?
It can be described in terms of programs, but isn't it also an electronic
configuration to be described at a lower descriptive level?

I reply that it is a computer at one level, but not at another.
That is, a computer can be 'reduced' to a configuration of electronic
states and events, in that that is what is there on the natural level of
electric currents, resistances, etc. in the same time and place as a com­
puter (so far as the same concepts of space and time can be applied to
both levels). But if there is no type of configuration of electronic states
and events, described on that physical level, in isomorphism with that
type of computer, then what happens on the electronic level only coor­
dinates with what happens on the computer level. These electronic
events and states do not occur--individually or as a whole--as the
activities of a computer. Hence this "system" is (at least) two corre­sponding systems of different natural levels, not one system transcend­
ing levels. Or perhaps there is such a type of electronic configuration.
Then what plays the computer's role in the computer-level can be char­
acterized electronically also. Then by closure, we have only one level,
not two--in which case the whole "system" belongs to one level, elec­
tronic potentials, memory banks, and all. In either case, this "system"
does not transcend natural levels.
C. ‘MULTI-LEVEL’ CAUSAL RELATIONS

But don’t we in general recognize that a wide variety of lower-level events cause higher-level events? Doesn’t an increase in the average speed of water molecules cause the water’s temperature to rise? (Searle’s example—informal communication.) Not, I say, if the cause has to occur before the effect. Bodies’ temperatures are in isomorphism with the average molecular speed through the relevant parts of the regions the bodies occupy in space and time. But the motion and the temperature are simultaneous. Simultaneous events or states do not, as such, cause each other.

(Hence temperature is of the same level with mean molecular speed. Note, though, that temperature is not the same as observed temperature, nor with warmth/coldness. So far as I can tell, these latter are of the ecological level, the former belong to a—different—physical level.)

D. PERHAPS THEORIES, RATHER THAN LEVELS, ARE REDUCIBLE

But isn’t it a theory, rather than a descriptive level as a whole, that might be reduced? I have asserted that, e.g., if a neurophysiological description has as its extension some sort of item which, on e.g., the psychological level, is described or referred to as an item playing a role in the interactive network described psychologically, then the two levels actually are one. But as Dennett has pointed out, it is not necessary that the neurophysiological types we now pick out be coextensive with the psychological types we now pick out. Further thought and experience leads us to abandon an old concept, adopt a new one, or modify an existing one. Indeed, we might modify a psychological type in order to make it coincide with a neurophysiological type. It would appear that one psychological theory picking out the right types could be reducible to neurophysiology, while another psychological theory concerned with different psychological items could not so be reduced.

Well, suppose that there are on the psychological level two theories T and U, which share no term special to the psychological level. Suppose further that T is reducible to neurophysiology in the way sketched above, and that U is not.

Is there some true description S relating some type of item referred to or described by a T-description of some type of item referred to or described by a U-description?

If not, then the family of all psychological descriptions containing those of T and U is not connected. (See Section 4.) Hence the two theories T and U did not belong to the same descriptive level after all.

Hence our supposing T and U to belong to the same level entails that there is such a description S.

But then, if T and U themselves are connected, it follows from closedness and completeness that the coextensiveness of that neurophysiological description or term and that description or term of T serves to show T and U together to be reducible to neurophysiology.
And in general, if one theory is so reducible, then by the same reasoning the whole descriptive level to which that theory belongs is reducible.

If either T or U is not itself connected, then apply the above reasoning to their several components.

VIII. CONCLUSION

I have defined ‘level of description’ as a closed, complete, connected family of descriptions having its special terminology, and ‘level of explanation’ as such a family, some members of which explain. Descriptive levels are founded on levels of nature to which they correspond and which they are intended to reflect. Natural levels are statistically closed, complete, connected domains of items, each domain specific to one natural level and not overlapping with the domain of any other natural level. Each descriptive level’s terminology is to refer to the corresponding natural level’s items; that is why a descriptive level’s special terminology is appropriate only to that level. It is because natural levels are closed, complete, and connected (in the sense that they are) that descriptive levels are closed, complete, and connected (in the sense that they are). It is a background, working hypotheses that there are distinct natural levels (and that it is safe to ignore any leakage), and a matter of translevel theory which are the natural levels that there are. I have indicated some ways in which my definition can be applied, given reasons to prefer my minimal definition to more detailed definitions such as that of Shaw and Turvey, and tried to remove some possible misunderstanding which could seem to undermine belief in natural—and hence descriptive—levels. I have not, however, argued that we should believe in levels—in general, nor in the particular levels in which Dreyfus, Gibson, Turvey and Shaw believe. This is better left for experience to decide.

ENDNOTES


3 No, this is not Logical Positivism. Logical Positivists assert that, to be meaningful, a statement must be verifiable—at least in principle. (A.J. Ayer, Language, Truth and Logic [New York: Dover, 1952], 35ff) Leaving aside the question of whether to be true or false is to be verifiable, to assert that the true or false is therefore meaningful is in no way to assume that the meaningful must be true or false. Nor is it Logical Positivism to assert that the meaningless cannot be true nor false: this is only the contrapositive of the non-positivist claim that the true or false is meaningful.

4 Shaw, R. and Turvey, M.T., "Coalitions as Models for Ecosystems: A Realist Perspective on Perceptual Organization", in M. Kubovy and J.R.


7 Dreyfus (1979, 211) refers to Russell only to reject his atomism. Gibson never refers to Russell, nor do Simon nor Pattee.


10 As Pattee suggests (Pattee 1973, xiii).

11 Dreyfus, 1979, 180.

12 Gibson, 1979, 96, 97, 99, 101.


15 Simon, 1969, 87.

16 Gibson, 1979, 12.

17 Dreyfus, 1979, 262.

18 As Gibson, 1979, does, Chapter 8, especially 127, 140-41.

19 Dreyfus, 1979, 180.

20 Classes of event belong to the same level as the individual items belonging to those classes. (Event e, of class E, is caused by event a of class A. This statement is of the same explanatory level as the statement that As cause Es, since reference is to that same causal network.) Classes and their members are of different 'type', in Russell's view (at least in "The Philosophy of Logical Atomism", in R.C. Marsh, ed., Bertrand Russell: *Logic and Knowledge* [New York: Capricorn/Macmillan, 1956], 175-281, especially 154, 274 ff.), but are of the same level in the Gibson-Dreyfus sense. Hence Russell's hierarchy of 'types' is not
straightforwardly commensurate with the Gibson-Dreyfus hierarchy of descriptive levels. By the way: for Russell, the perceptual event is the 'individual' or fundamental type of experience, with all other types classes of these, classes of classes of these, etc. Neutron bombardments, etc., are theoretical constructs, and of another realm. This position could be interpreted as claiming implicitly that the latter are of a different natural level from that of experience; and that all type-levels of experience belong to the natural level described along other lines on the psychological level. Similar reasoning leads me to count Shaw's and Turvey's 'coalitions' of four 'grains' of explanation as of one level, even though Shaw and Turvey (1981) do suggest that the term 'level' corresponds rather with their preferred term, 'grain'.

21 Gibson, 1979, 307-09.
22 Dreyfus, 1979, 177.
23 Gibson, 1979, 8.
24 Pattee does claim that two "levels of description" would be needed: one for purposes of prediction, another for purposes of control. (Pattee 1973, 142-43) But see my Section 7.
25 Gibson, 1979, 218.
26 Dreyfus, 1979, 262-63.
27 Dreyfus, 1979, 232.
28 Dreyfus, 1979, 265-66.
29 Dreyfus, 1979, 178.
30 Dreyfus, 1979, 254.
31 Note that it is descriptions and theories of Dreyfus and Gibson, and not the psychological level itself, I call "direct and naive realist." This distinction's importance will be obvious in my discussion of Shaw and Turvey. For Dreyfus, see Dreyfus, 1979, 265-66, 268-69. As for Gibson, Henle ("On Naive Realism", in R.B. MacLeod and H.J. Pick, Jr., eds., Perception: Essays in Honor of James J. Gibson [Ithaca, NY: Cornell, 1974], 40-56.) has asserted that he is really a critical realist, but this is a mistake. She assumes that Gibson would agree that "the world we see and feel is the phenomenal world, not the physical world" and that "we keep in touch with the physical world" not because we deal directly with it, but "because our phenomenal world is, on the whole, veridical," (Henle 1974, 41) and that Gibson thinks himself a naive realist because he wants to avoid locking himself up "in a world of subjectivity". (Henle 1974, 42) Such a view is critical realism, not naive realism. (Henle 1974, 44) She also notes that Gibson seems to reject Koffka's formulation of direct realism, that "things look as they do because they are what they are." (Henle 1974, 44. Gibson, J.J., "The Legacies of Koffka's Principles", Journal of the History of Behavioral Sciences 7 (1): 3-9, 1971. Koffka, K., Principles of Gestalt Psychology [New York: Harcourt, Brace, and World, 1935], 77) Yet Henle recognizes Gibson's account of 'affordances' as naive realist. (Henle 1974, 51) But critical realists try to get at the physical world through critical appreciation of their phenomenal world.
LEVELS IN DESCRIPTION AND EXPLANATION

(See Sellars, R.W., "The Aim of Critical Realism", in R.J. Hirst, ed., Perception and the External World [New York: Macmillan, 1965], 235–44.) Gibson denies that we are even ordinarily aware of a phenomenal world in our awareness of the environment, and asserts that we do not use the phenomenal for an inferential step to the environmental world. It is as an environment existing independently of our awareness that we are aware of it, and this is naive realism. (See Carleton, L.R., "Toward a Defense of Direct Realism", Auslegung 5(2): 101–11, 1978.) Gibson's thesis, that "things look as they do because, first, the available stimulus information is what it is and, second, attention is paid to certain features of this information", (Gibson 1971) is naive realist: the information is what it is because the environment is what it is, and is so independently of our awareness of it.

32 The following argument is adapted from Carleton, L.R., "Perceptual Objections", Synthese 41: 309–20, 1979.

33 Other additions to this level, not contemplated by Gibson (nor Dreyfus), could be the 'schema' of Neisser, U., Cognition and Reality. San Francisco: Freeman, 1976; and the 'econiche' and 'effectivity' of Turvey and Shaw 1979.

34 Shaw and Turvey, 1981.

35 Shaw and Turvey, 1981, 356. But they also allow other terminology, esp. that of physics and physiology, a place in their version of the psychological level.

36 Shaw and Turvey, 1981, 344.


40 Shaw and Turvey, 1981, 368–70. See also 373.


42 Some of which has been said in work already cited herein by Gibson, Dreyfus, Turvey, Shaw, and Carleton.

43 Pattee, 1973, 133.

