Touch and the Primary Qualities

by

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ABSTRACT

I give an account of the sense of touch by means of a classification scheme which classes properties of objects as tactual or non-tactual. This classification scheme begins with a class of properties, the tangible properties, delimited by the following: A property P is tangible if and only if it can be correct, on occasion, to say of an object that it feels P or feels to be P. "Tangible" is used here merely as a convenient name for this class of properties. I then present the complex differentia which, within the genus of tangible properties, characterize the species of tactual properties or properties which belong to the tactual sense-mode.

Chapter II is devoted to presenting this taxonomy of the tactual sense-mode. Chapters III and IV investigate various relations between the classificatory devices introduced in Chapter II and certain other characteristics of properties of objects.

In chapter III, the primary/secondary distinction among properties is related to the simple/complex distinction. The simple/complex distinction occupies an important position in the functioning of the taxonomy I present. A secondary property is either simple or reducible to simples, and a primary quality is a complex property of one or more sense-modes, and hence is not reducible to simples. These two ways of characterizing properties have various other interconnections, and the taxonomy I present, using the simple/complex distinction, serves to clarify certain aspects of the primary/secondary distinction.

Chapter IV is an investigation using the simple/complex distinction, of the primary/secondary distinction among properties, and of the sorts

of dispositionality a property may have. These three ways of characterizing properties - primary or secondary, simple or complex, and dispositional or non-dispositional - have many interrelations which I investigate, finding that the three are mutually illuminating.

In the final chapter, I consider the question of why it is that the sense of touch has no secondary properties which are peculiarly its own. Touch differs from the other sense-modes in this way; for instance, color is a secondary property belonging particularly to vision. For various reasons, only some of which I explore, the sense of touch is intimately related to primary qualities.

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I. On Differentiating Sense-Modes

There are several sets of considerations one might use in differentiating the sense-modes. One might (1) attempt to distinguish them by using the differing experiences characteristic of the operations of the various sense-modes; we presumably know which sense-mode is operating at a given time, and this immediate knowledge is to be explained, though not justified, by considering the characteristic experience of seeing, say. Or, (2), one might attempt to distinguish the sense-modes on the basis of the features we become aware of through them; this is the procedure I follow. Or, (3), one might use the general conditions surrounding the use of a sense-mode to distinguish it from the others, e.g., touching involves physical contact with an object. Lastly, (4), the operative internal mechanisms might be used to differentiate the sense-modes.

The first alternative, using the introspectable character of the sensing act, seems very unpromising. How does one characterize a sense-experience without discussing the features perceived? But this leads us to (2). Apparently (1), if it is workable at all, cannot stand by itself. The last alternative, (4), seems unacceptable, since if differentiation of the sense-modes depends on knowledge of the internal mechanisms involved, how were we able to distinguish them before we had knowledge of those mechanisms? Suggestion (3) has failings also. The general conditions surrounding the exercise of sight would be something like a requirement that our eyes be open and directed at the object being looked at. This alone only provides necessary conditions; that our eyes are open and directed at an object does not imply that we are looking at that object. The argument is going to have to

be more complex if (3) is to be useful. Let us assume that we have knowledge of some of the properties of an object, and are trying to determine whether it was through vision that we gained that knowledge. We would have to know which sense-modes there were, and know that none of the others were operating before we could conclude that vision was the sense-mode which indeed was operating. To make (3) workable we not only have to know the conditions for the operation of each of the sense-modes; we have to know that we have taken all of the sense-modes into account. This requirement may not be a serious drawback to the use of (3), but it is a reason for our looking to some of the other methods for differentiating sense-modes. There is one other problem with (3) which is more serious: it is too restrictive. I propose that the only sensible, non-technical formulation of the general conditions surrounding the operation of touch is that if one is perceiving by touching, one must be in physical contact with the object being investigated. This formulation excludes some uses of "feels warm" from being properly tactual. I can feel the warmth of an object even though I am not in contact with it; I am sensitive to radiant heat. Certain uses of "warmth" are thereby excluded from full and literal use as naming a tactual property; but surely it will need arguing that "feel", in some instances of uses of "feels warm", are deviant, and are somehow metaphorical. There is no room for argument, though. If the above statement of the surrounding (and necessary) conditions for touching are accepted, the conclusion that some uses of "feels warm" are deviant follows. The only sort of argument that I see for using approach (3) is that the other approaches have been shown to fail.

From this brief discussion of the problem, all of the approaches except (2) have been shown to be at least initially unpromising. Some combination of the various approaches might work; I shall not investigate that possibility, however. I have chosen to investigate using approach (2) - it seems the most promising, and the only one of the four against which no initial objections hold.

I want to investigate the differentiation of the sense-modes using consideration (2) alone. This approach is the attempt to differentiate the sense-modes by means of the features (properties of objects) which we become aware of through them. An initial classification device used in my investigation makes use of the perceptual verbs "look", "feel", etc., to delimit classes of properties. If a property P is a tactual property, then it must be correct, upon occasion, to say of some object that it feels P. Thus, the class of tangible properties includes all those properties of objects for which it can be correct to say "It feels P", or "It feels to be P". "Tangible" has a special use here, and is used merely as a convenient name for this class of properties. My approach makes free use of the perceptual verbs, and I think that consideration (1) offers the means for a plausibility argument to the effect that such an unguarded use of the perceptual verbs will not be a source of error. Presumably we immediately know, perhaps on the basis of introspectable differences in the experiences, which sense-mode is operating; and presumably our use of the special perceptual verbs has been patterned accordingly. However, these assumptions do not enter into the actual classification procedure.

II. A Taxonomy

I intend to give an account of the sense of touch by showing how the properties of objects may be distinguished as tactual and non-tactual. If P is a tactual property, then it can be correct for an observer to say of some object that it feels P. I will make use of the perceptual verb "feel" to delimit a class of properties, the tangible properties. "Tangible" has a special use here, merely serving as a name for a class of properties.

> A property P belongs to the class of tangible properties if it is correct to say of some object that it feels P or that one can feel it to be P.

There are various uses of "feel", some of which we commonly take to be metaphorical and non-tactual, e.g., "feel" in "He feels the tension in the room". Consequently, not all tangible properties will be tactual properties and belong to the tactual sense-mode. I shall state the complex differentia which mark off, within the genus of tangible properties, the species of tactual properties, or properties which belong to the tactual sense-mode.

I do not undertake to give an analysis - even a partial one - of how it is that one can be aware of the properties of objects or of the movements of one's body. I accept the general claim that our knowledge of the properties of objects is in some way due to the changes caused in us by the objects perceived. For my purposes, however, it is sufficient that our claims to knowledge of the properties of objects and of the movements of our bodies are in the main true.

Tactual Determinability:

The properties which we become aware of through any of the sense-modes may be characterized in two ways. I call these two ways "determinability" and "complexity".

I introduce here the phrase "primary test". A primary test for the presence of some property P is a kind of test which is not inferior in respect of reliability to any other kind of test for P. The reliability of a test is judged by its degree of past success, and there may be, of course, more than one primary test for a property. Two sorts of test may be equally reliable and successful.

The following definitions are formulated using the perceptual verbs of the tactual sense-mode. By systematically replacing "feel" by "look", "tangible" by "visible", and "tactually" by "visually", the definitions will apply to the visual sense-mode. And by using the perceptual verbs of any other sense-mode, the definitions would be appropriate to that sense-mode.[1]

(1) Direct Determinability:

A tangible property P is for some observer directly tactually determinable if and only if a primary test for some object's being P is that it feel(s) P to him.

[1]In developing this account of the tactual sense-mode, I have drawn very heavily on H.P. Grice's taxonomy of the visual sense-mode. I have used a number of his classificatory devices, adapting them to the tactual sense-mode. Grice's classification scheme begins with a class of visible properties: any property P for which we can say "the object looks P" is a visible property. With this classificatory device, Grice begins his attempt to distinguish the sense-modes by means of the properties which we become aware of through them. My account of the tactual sense-mode parallels Grice's for the visual sense-mode.

H.P. Grice, "Some Remarks About the Senses", Analytical Philosophy, R.J. Butler, Ed., Barnes and Noble, New York, 1966, pp. 133-153.

Whether a property P is directly determinable for some person depends on his perceptual skills. If, for some person, P is directly tactually determinable, he is sufficiently skilled so that the object feeling P to him is a primary test that it is P.

Examples of properties which are tactually directly determinable for most observers are degree of hardness, roughness, smoothness, elasticity, warmth, stickiness, and certain determinates of shape and size - which of these determinates will be discussed later.

Some of those properties which are tangible are separated from the tangible and tactual by use of primary tests. It is not a primary test for the expensiveness of an article of clothing that it feel expensive, nor is expensiveness indirectly determinable. It is not a primary test that the people in a room are tense that someone feels the tension in the room. The classification scheme which I develop to distinguish the tactual properties depends, though indirectly, on this use of primary tests.

I assume throughout that standard observational conditions obtain. And given that standard conditions do obtain, an observer for whom P is directly determinable may, if he wishes to check himself, repeat the same primary test to determine that the object is P. If a test is a primary test, there can be no objection to an observer checking himself by using the same primary test again. In complex situations, when something has gone wrong, and there is suspicion that the test thought to be primary is not so, other tests should be used.

(2) Indirect Determinability:

A tangible property P is tactually indirectly determinable for a person if: (a) for that person, P is not directly determinable,

and (b) for that person, a primary test for some object's being P is of one or both of the following two sorts. (1) The relation test: by this, one determines that the object is P by discovering through examination that its parts or components have certain characteristics or are related in certain ways; these parts, components, characteristics and relations must themselves be tactually directly determinable. (2) The comparison test: by this, one determines that the object is P by comparing it tangibly with a standard which is known to be P. (By comparing tangibly, I mean that these conditions must be met: one must be able to say "I know that the standard is P, and the object being tested feels the same as the standard with respect to P-ness".)

Direct and indirect determinability are person-relative and skill-relative. A property may be directly determinable for one person and be indirectly determinable for another.

Examples of properties (when they are not directly determinable) which are indirectly determinable and for which the relation test is appropriate are approximate squareness, roundness, and most other distinguished shapes. Elasticity, roughness, slipperiness, and hardness can also be indirectly determinable.

Examples of properties for which the comparison test is appropriate are length as measured by comparison with a standard length, and any shape which is identified by comparison with a template.

Squashability is a property which is indirectly determinable, and for it as well as for elasticity and degree of hardness, the relation test is appropriate. I squeeze a rubber ball and can feel it squash. Before I squeezed it, it felt round. Squeezing is a way of feeling, and if I am trying to determine whether the ball is squashable, I determine whether it squashes; that is, I determine that certain relations held among the parts before I squeezed, and that as I squeezed, these relations changed in certain ways. If I am investigating the degree to

which the ball is squashable, I may do so by considering the rate of distortion relative to the increase in pressure. It seems to me that we do judge properties like squashability and degree of hardness by investigating the rate at which the object changes shape as we apply increasingly more pressure. Our abilities to judge hardness by means of this relation between degree of pressure exerted and change of shape induced are not of direct concern to me. It is that ability, however, that explains how hardness can be directly determined.

In directly determining that an object is hard we need not explicitly notice the degree of the deformation. But when an object is indirectly determined to have a certain degree of hardness, the extent of the deformation brought about by a certain pressure is explicitly noticed. There is implicit in any judgement of degree of hardness, of squashability, or of elasticity, the use of a standard. The scale of degrees of hardness or of degrees of elasticity is established by taking certain objects as standards. The use of the standard is not necessarily one of direct comparison with the object presently being investigated, however. We sometimes want to rank objects with respect to degree of hardness or of elasticity, and this ranking can be performed treating degree of hardness as either directly or indirectly determinable. If the ranking is performed treating degree of hardness as directly determinable, then the ranking is with respect to that absent standard which serves to establish the scale. If the ranking is performed treating degree of hardness as indirectly determinable, then one object is investigated, and its degree of hardness determined, and then a second is ranked with respect to it, and so on, where the standard is then any

one of the previously ranked objects. This sort of ranking procedure combines the relation test and the comparison test.

Whether for a given person a property is directly or indirectly determinable depends primarily on that person's perceptual skills. Even the shapes of large objects may be tactually directly determinable for some person; for most of us they are tactually indirectly determinable. If I investigate a large object by following its edges with my hands and fingers, I may be determining its shape directly or indirectly. Merely because an observer is performing a set of actions in investigating the object does not imply that he is determining indirectly its shape. He may or may not need to pay attention to, to explicitly consider, the relations among the parts of that object. Consider the case of a man investigating some complex shape, where it is analytic that because this object has certain relations among its parts, it is of shape A. The investigator need not know the analytic connection in order to be able to identify the shape. He may simply be able to recognize A-shapes. But because he does not know the analytic connection between being A-shaped and having certain relations among the parts, our investigator could not have determined the object to be A-shaped by determining that certain relations hold among its parts.

Assuming that the observer correctly reports his methods of investigation, he is directly determining the object to have some property P if he tells us merely that the object feels P. If he says that the object feels P_1 and P_2, and therefore is P, he is indirectly determining the object to be P.

To determine tactually the shape of a large object we must move our hands and sometimes our bodies. If the shape is determined directly, a very complex characteristic, which is perceived as extended in time, must be recognize directly. And therefore, for reasons of convenience, we commonly treat the shapes of large objects as tactually indirectly determinable. We learn what relations hold among the parts of objects of various shapes, and determine objects to have those shapes by determining that certain relations hold among their parts. The necessary recognitional skills are thereby kept much simpler.

The limits on what properties may be determined directly, for either sight or touch, depend on whatever limits there are on the degree to which we can develop certain perceptual skills. And presumably the limitations depend in part on the complexity of the property being investigated. (At this point in my investigation, the complexity of a property is to be understood as the complexity of the relations among the parts which are determined in indirectly determining that property.) There will be some upper limit then, on the degree of complexity a property may have if it is to be directly determinable. And this limitation on complexity will be in some way related to our general intellectual abilities.

The directly/indirectly tactually determinable (by the relation test) distinction among properties commonly coincides with the line between properties which can and ones which cannot be investigated without large movements of the investigator's arms and torso. There is a corresponding distinction for sight; when we must change our point of view - must look at an object from more than one point of view - in order to determine

that it has some property, we commonly treat that property as visually indirectly determinable. Properties are sorted in this way presumably because for most people the difficulties involved in acquiring these added perceptual skills override the benefits to be gained from direct determinability.

Tactual Complexity:

(1) Tactually Simple Properties:

> A tangible property P is tactually simple for some person if and only if he can give no answer to the question: "What is it about the way the object feels that makes it feel P?" If any tactually directly determinable properties of the object, other than P, can be given as the reason it feels P, then P is not tactually simple.

Simplicity is person-relative and skill-relative; to use an example from the visual sense-mode, blue may be a simple property to one person, and for another be non-simple. The person for whom the property is non-simple may say that the object looks azure and therefore looks blue. This sort of species/genus relation is somewhat odd, and perhaps doesn't fit well with intuitive notions of what complexity in a property is like. Under my definitions it is nonetheless an allowed case.

There are few tactual simples. Examples of tactual simples are waxy-feeling, greasy-feeling, and metallic-feeling.

Tactual simples are indicated with various locutions; the device I have adopted, where greasy-feeling and waxy-feeling name simple properties, seems to me a good device to illustrate the way we do name tactual simples. A paradigm feel is identified by reference to the type of material that usually causes such a feel, and a name for the feel is constructed out of the name of the substance. That an object is waxy-feeling means that to

most observers the object would feel as if it were made of or covered with wax. That an object is waxy-feeling does not imply that it is made of wax, nor does the fact that an object is made of wax imply that it is waxy-feeling. We do have various devices that allow us to distinguish the feels of objects without thereby committing ourselves to the object having any other properties, and this sort of device is used to identify tactually simple properties. Also, there seem to be no tactual simples which are named other than by this sort of linguistic device. There are various reasons why this is so, and the question will be taken up again in the last chapter.

That simpleness is person-relative and skill-relative does not threaten the claim that there are tactual simples. Even if blue is not a visual simple for some person, some of the particular shades of blue which he can identify will be simples. Similarly with tactual simples: if greasy-feeling is not a simple for someone because he can give various kinds of greasy-feels as reasons for a thing being greasy-feeling, some of those more particular kinds of greasy-feel will be simple. Greasy-feeling is no longer a simple because it is the generic name of a group of properties such as buttery-feeling, which are simple. It should be noted that I am concerned with sufficient conditions for an object to have some property P. Slipperiness is not a sufficient condition for greasiness, though it is a necessary condition; here I'm concerned with the entailment relations among properties.

Simplicity is person-relative and skill-relative. But it will be a much more useful sort of classification if the relativity can be reduced or removed. This relativity is not a great hindrance in dealing with

simples, but it is in dealing with non-simple properties. I propose to use the following qualifying condition: a property is directly determinable if some humans (without physiological abnormalities) can learn to determine that property directly. Which properties humans can learn to determine directly depends on their sensory abilities and the degree of skill which can be acquired in the use of those abilities. The above is equivalent to something like the assumption of a maximum level of perceptual skill. An average level of perceptual skill could have been invoked to fix the degree of person-relativity and skill-relativity; but this method is not so useful as the first; more properties can be classified using the first condition, and problems with changing levels of skill do not arise. I will use the first method to remove person- and skill-relativity from the classifications of simple and complex properties.

Any simple property is directly determinable, or is indirectly determinable by the comparison test only - not by the relation test. A property P is tactually simple if there are no other tactually directly determinable properties which imply P, or can be given as a reason an object is P. With the assumption of a maximum level of skill, any property which can be directly determinable is directly determinable. If a property is simple, then it is so with no riders about person- and skill-relativity.

Touch differs significantly from sight in the way simples function in the two sense-modes. Some colors are visual simples, and we find color a very important property, and make frequent use of it. Degrees of light and dark are visual simples, and without color and degrees of light and dark, we would have no other visual properties. Touch is not at all like sight in this respect. If we were to just ignore all tactual simples,

nothing very important would be lost as a consequence. We would still be able to make almost all of the perceptual discriminations we might want to make. Touch has few simples, and they are relatively unimportant because they are not often combined to give non-simple properties, nor are they used as markers which provide means whereby we can know other properties.

Properties like shapes are clearly not tactual simples, since there is always something to be said about how the parts of the object are related which will explain how it is that the object has the shape it has.

The properties of hardness and elasticity are not tactually simple, because relations among the shapes of the object at different times can be given as the reason the object feels to have one of those properties. The property P is not simple whenever, in answer to a question about what the object feels like, an answer of the following form can be given: "It feels Q (or Q,R,S), and then a bit later it feels T (or T,U,V), and therefore it is P". (Q,R,S,T,U, and V are tactually directly determinable properties.) Of course, properties may be non-simple in other ways also.

Hardness has sometimes been thought to be a simple property, and so have some other properties. If a property is simple, the way an object feels when it has that property is not further characterizable; this situation might tempt us to talk about the simple feel of hardness, say. But this way of talking would not be misleading if hardness were a simple property; then, in a perhaps not quite straight-forward way, we would just be pointing out that hardness was a simple. However, hardness is not a simple, and for any property which is not a simple, it will be very misleading to speak of the feel an object has in virtue of having that

property. When the property in question is not simple, talk of the peculiar feel of the objects that have that property will inevitably sound odd, just because the property is not simple. We would have to distinguish between the meanings of "the object feels hard" and "the feel the object has because it is hard", and we have not been provided with means for so distinguishing. We cannot independently specify the feel in the way required. Of course, if the property is simple, then we can quite sensibly talk about the feel the object has in virtue of being greasy-feeling, say. It is a greasy feel, and we determine that objects are greasy-feeling by determining that they do have the appropriate kind of feel; there is no other way to determine simple properties. When the property P is simple, it seems acceptable to refer to a characteristic feel, and to explain "feels P" by referring to that characteristic feel. For non-simple properties, we explain "feels P" by pointing out other properties that the object has that are the reason it feels P.

Smoothness and roughness are not tactual simples; they are spatial properties, and as has been claimed, for a spatial property P there is always something to be said about how the object feels which explains why it feels P. In answer to the question: "What is it about the way this surface feels that makes it feel smooth?" we can point out that each adjacent, small area of the surface is of approximately the same height as the average heights of the two small areas adjacent on either side to the first. However, smoothness is context-dependent in that I can say of a piece of corrugated roofing material that it is smooth, meaning that though its surface is smoothly wavy, there are no other tactually detectable

unevennesses in the surface. Thus when we say that some surface is smooth, we assume a context, and are concerned with some range of sizes of areas and unevennesses, such that if we find the appropriately sized unevennesses in the appropriately sized areas, the surface is not smooth. The sort of answer offered above to the "what makes it smooth" question contains the beginnings of a definition of smoothness; a grid of the surface is assumed, and relations between area elements of that grid are specified. The context of the investigation then either implicitly or explicitly serves to calibrate the grid, and to indicate the size-ranges being investigated.

An answer to the question "What is it about the way the surface feels that makes it feel rough?" can be similar to that for smoothness, except that for roughness, of course, the deviations from smoothness, the varying heights of adjacent small areas, is the reason that the surface feels rough.

When we are trying to determine whether a surface is smooth, we commonly draw a finger across it. Moving one's finger over an object is a way of feeling, and no new factors are introduced by feeling in different ways. If I am trying to determine how smooth a desk-top is, I will probably move my fingers over it. Not only am I concerned to investigate larger areas, and for that reason move my hands and fingers, but when moved slowly over the surface, my fingers are more sensitive to unevennesses than if they merely rest on the surface. I am not concerned here with ways of investigating particular properties; I wished to stress that moving one's fingers around over a surface is a way of feeling, and does not in itself

indicate anything about the simplicity or non-simplicity of properties.

Of the tactual properties mentioned here, all but the tactual simples and warmth involve spatial properties: for these tactual non-simples, the characteristic answers given to the "What is it about the way the object feels that makes it feel P?" question make reference to spatial properties and spatial relations between parts of the object. And all spatial properties are non-simple: if P is a spatial property, something can always be noted about the way the parts of the object are related, or about spatial properties of the parts, which is a reason for the object feeling P. Thus if a property involves spatial properties, in the ways given above, or is a spatial property, it is non-simple.

The more important tactual properties, the use of which we could not forego without serious consequences, all involve spatial properties. The tactual simples do not involve spatial properties, and they seem to be relatively unimportant; no significant changes in our abilities to deal with the world would result from giving them up.

(2) Tactually Non-simple Properties:

There are three sorts of property I want to discuss. The three are: tactually tightly complex, tactually loosely complex, and tactually indicable properties.

(i) Tactually Tightly Complex Properties:

> A tangible property P is tactually tightly complex if and only if an object's having P is entailed by its having other properties which are themselves tactually directly determinable or simple.

Tightly complex properties cannot be simple, since in answer to the question "What is it about the way the object feels that makes it feel P?" we can specify any set of directly determinable properties which entail that

it is P; tightly complex properties, by definition, will always have such a set of properties.

Sometimes the entailment runs both from the set of directly determinable properties to P, and from P to the set of directly determinable properties. If an object is square, then because it is square it has certain relations among its parts and no others. Squares, circles, and other simple geometric shapes are of this sort.

Spatial properties such as being square, circular, ovoidal, and octagonal are tactually tightly complex properties. Hardness, elasticity, malleability, smoothness, roughness, and stickiness are also tactually tightly complex.

Tactual complexity is to an extent person-relative and skill-relative. The definition of tactually tightly complex uses direct determinableness, which is person- and skill-relative. The same qualifying condition will serve to remove the relativity for complex properties as for simple properties. A property is tactually directly determinable if it <u>can</u> be directly determined, i.e., if that skill can be acquired. Some maximum level of perceptual skills is assumed; this serves to provide the set of tactually directly determinable properties which then are used to explain complexity and simplicity.

What is specified when the determining characteristics which make the object feel P are given? Consider a tactual investigation of a plane, circular object. One investigates the shape by tracing the edge of the object with the fingers and by making passes across the center of the object to determine if there is a center from which the edge is always equidistant. How are the results of this investigation reported?

One says: "I feel the edge of the object; as I move my hand along the edge, I can feel that it is continuous, and that the curve of the edge is circular or nearly so". But what else can be said to explain "I feel the edge of the object" and "I feel the edge to curve in a circle"? An explanation can be given describing what happens when I move my hands in certain ways, but this sort of description is no more basic than the other, and the two sorts of description can with care be put in a mutually implicative form.

Any property which we might use to explain the complexity of the property of being circular is itself complex. And then when the complexity of this second property is analyzed, other complex properties are used. The spatial properties,and any other properties which involve spatial properties, are irreducibly non-simple, and because of the interrelations among the spatial properties, we can expect that an explanation of the complexity of some one spatial property can be circular. Such circularity is entirely harmless, however, since directly determinable properties must be used to analyze the complexity of any property.

(ii) Tactually Loosely Complex Properties:

> If P is a tangible property, and is not simple or tightly complex, it is tactually loosely complex if and only if it depends upon tactually directly determinable properties in the following way: if two objects have identical sets of tactually directly determinable properties, then if one of them has the tactually loosely complex property P, the other must have P as well.

It is because an object possesses this set of tactually directly determinable properties that we judge it to have the loosely complex property P. And if we are asked to explain why we think it to have P, we will produce a list of the tactually directly determinable properties which we think account

for the object's having P. But from no such list can it be deduced that the object does indeed have P; and this is how loosely complex properties differ from tightly complex ones. Tightly complex properties are related by entailment to some one or more set(s) of directly determinable properties. Tactually loosely complex properties have some sort of meaning-relation to the set of directly determinable properties which we think account for an object's having the loosely complex property; but the meaning-relation is not entailment.

Consequently, there is considerable room for disagreement in ascribing to objects loosely complex properties. Someone may disagree with my judgement that some object has some loosely complex property; he need not be wrong, but may be attending to a somewhat different set of directly determinable characteristics than I. If we persist in comparing our judgements and the reasons we give for them, we may reach agreement, or at least an understanding of how we differ in applying the given property word. But neither of us was wrong; the rules for application of loosely complex words are not sharp.

Aesthetics provide many examples of this sort of property. To say of a piece of sculpture that it feels graceful, delicate, clumsy, and so on, is to use adjectives standing for properties which are loosely complex. In each case, it is because of the tactually directly determinable properties of the object that it is said to have some loosely complex property. But in no case is there a set of characteristics which entail that the object has the given loosely complex property. The only explicit restriction on the ascription of such properties is that given that two objects have identical sets of directly determinable

properties, or of relevant determinable properties, one cannot be said to have some loosely complex property and the other not. Of course, there are considerations of appropriateness which we do make in applying loosely complex property words; but for loosely complex properties, appropriateness is not related by entailment to any set of directly determinable properties.

(iii) Tactual Indicability:

> A feelable property P is tactually indicable if and only if in explaining why we take an object to have P, various tactually directly determinable properties are specified whose presence make it probable, indicate fairly reliably, that the object has P.

There is no absurdity involved in the assumption that there should be an instance in which an object possessed all of the tactually directly determinable properties which normally indicate that it has P, and yet that it is not P. Nor is there an absurdity in the assumption that two objects should have identical sets of tactually directly determinable properties and yet one have and the other not have some tactually indicable property. Thus P is merely indicated by the presence of some sets of tactually directly determinable properties. And consequently, tactually indicable properties are neither directly nor indirectly tactually determinable, since primary tests for indicable properties must be other than those allowed in direct and indirect tactual determinability.

Examples of tactually indicable properties are being-made-of-wood, metal, wax, plastic, etc. An object could have all of the tactually directly determinable properties which normally indicate that it is made of wood and yet not be. There is no absurdity involved in such an assumption; the various tactually directly determinable properties merely

indicate fairly reliably that the object is made of wood. Other examples of tactually indicable properties are: feels-as-if-it-will-last (said of a piece of furniture, say), and feels-as-if-it-would-look-graceful.

The Classification Scheme:

All of the classificatory devices which I use have now been presented. Various relations hold among the classificatory properties, and these relations need to be examined before a classification scheme for the tactual properties can be presented.

If a property is simple, then it is either directly determinable, or indirectly determinable by the comparison test. A simple property cannot be indirectly determinable by the relation test. If P is a simple property then an object which has P has no other directly or indirectly determinable properties which are the reason that the object feels P; there are no parts of the object which are characterized by such determinable properties, and a fortiori, no relations among the parts; which is just to say that the relation test is inapplicable.

If a property P is indirectly determinable by the relation test, then it is tightly or loosely complex. If in order to determine that the object has P, one must or can make sure that the parts of the object are related in certain ways, and that those parts and relations are characterized by certain directly determinable properties, then those directly determinable properties and relations can be given as the reason that P is complex, and to explain how P is complex. And if a property is tightly or loosely complex, then it can be indirectly determined by the relation test. Thus there is an equivalence between being tightly or loosely complex, and being indirectly determinable by the relation test.

If a property is indirectly determinable it can be so determined, though it may for most or all people be directly determined. Many properties are both directly and indirectly determinable. I have treated the relation as follows: if a property can be indirectly determined, then it is indirectly determinable. This does not preclude the property being directly determinable also; it can be both, but not to one person at one time.

I am now in a position to state the requirements, according to my classification scheme, for something to be a tactual property.

> All tactual properties are either (a) tactually tightly complex, (b) tactually loosely complex, or (c) tactually simple. All and only those properties are tactual, which are tactual simples, or whose correct ascription depends, though perhaps not solely, on logical relations among tactually directly determinable properties.

In summary, the classification scheme works as follows. A class of properties, the tangible properties, is delimited by: P is a tangible property if and only if it can be correct to say of some object that it feels P or feels to be P. The tangible properties include some properties which we clearly do not think of as tactual, and these are excluded by the criterion of direct determinability. Tactual simples must be directly determinable, and tightly and loosely complex properties are explained by pointing out the logical relations holding between complex properties and the directly determinable properties which are used to analyze them. The classification scheme rests on the notion of direct determinability: all properties which are tactually directly determinable are tactual, though the converse doesn't hold.

If I were intending to rule on which properties are tactual, I would adopt the above classification scheme. Such legislation seems both unwise and unnecessary; I take it that the success of the classificatory scheme presented depends upon its success in delimiting a class of properties which correspond closely with those properties which we usually take to be tactual, and in excluding those which we do not usually think are tactual. These requirements are somewhat loose; there may well not be a consensus as to whether some given property is tactual. Consequently I do not think it particularly interesting to rule on the tactuality of some problematic property. What is of interest, and what makes a classification scheme useful, is the extent to which such a scheme can reveal reasons for a property being considered, e.g., a tactual, property.

The later parts of this paper will be an investigation, making use of the classification scheme developed, of some of the various conceptual relations and general facts about the world which may explain why certain properties have been grouped as tactual.

III. Primary and Secondary Qualities:

The distinction between primary and secondary qualities has appeared in the works of many writers. I will mention only Locke's[2] lists of properties, which he distinguishes as primary and secondary, and will take it as sufficiently evident that his form of the distinction will not do. And, I will present briefly what I think is an acceptable way of distinguishing between the two sorts of properties.[3]

According to Locke, an object's primary qualities are solidity, extension, figure, and mobility. The secondary qualities of an object are its color, temperature, smell, taste, and sound.

Most humans can see and distinguish a certain range of colors. It is a fact about the world that our color vision is dependent in a complex way on the wavelengths of the light-rays that strike the retinas or our eyes.

Presumably then, if our techniques of microsurgery were sufficiently developed, an operation could be performed which would remove our ability to see color caused by light of the wavelengths associated with violet, or of any wavelength less than that. If this were done, we would no longer be able to see certain colors which we now do see.

[2]Locke, An Essay Concerning Human Understanding, Dover Publication, Inc., New York, 1959, Vol. I, Book II, Chap. VIII, p. 170.

[3]In presenting what I take to be a correct version of the primary/secondary distinction, I will draw heavily on a paper by Jonathan Bennett, "Substance, Reality, and the Primary Qualities". I think his account of the distinction is correct, and find it very useful for certain of my purposes.

Jonathan F. Bennett, "Substance, Reality, and the Primary Qualities", American Philosophical Quarterly, 2, 1965, pp. 1-17.

A similar argument could have been used, where the results of the surgery were that our color vision was removed entirely, leaving only degrees of intensity, of dark and light, for us to distinguish among.

In either case, we are no longer able to make certain discriminations among the properties of objects that previously we could make. Is this a possible situation? Would we not be able to make those discriminations at all? Or would we be able to do so, but by some other means? Making use of knowledge of the human eye and of how that organ functions, we could make devices which would give readings which would be correlated with the color discriminations we once were able to make. That is, this device would be scaled so that a given wavelength distribution in the light entering the device would be indicated to be a certain color. Now the way this device is to be designed and read is modeled on the human eye. The result is that the initial assumption, that we were no longer able to make color discriminations with our eyes, has in a certain way not been honored. A device which duplicates the functioning of the human eye depends for its design on knowledge of the functioning of the human eye; and if we were to be consistent in assuming that we alter our eyes so that we cannot make color discriminations with them, then similar alterations should be made on eye-like devices.

These complications may be left to one side, however. To make my point all I need to assume is that we do not make any such eye-like devices, and that we do alter our eyes in the ways outlined. Then: can we somehow make discriminations corresponding to our previous color discriminations? I think that we cannot. Without color vision, the only way we could make

discriminations like those of color would be through other properties that we could determine. These other properties would have to be connected with our color discriminations in such a way that an object having a certain set of non-color properties entails that it is some color. The only even slightly plausible set of such properties is the wavelength distribution of the light reflected from the object, which would strike our eyes if we were looking at that object.

It seems to me a very open question whether we are to say that some particular wavelength distribution of reflected light entails that the object is of some particular color. We could decide to treat the connection between color and wavelength of light in this way, but it is not at all clear that we now so treat it. Most people don't know anything, in detail, about wavelengths of light, and this is a reason for saying that the meanings of color words don't now have anything to do with wavelengths of light. But even if we did consider the meanings of color words to be about both colors and wavelengths, we can sensibly imagine treating the connection between color and wavelength as other than a meaning connection, so that only a causal implication relation would hold between them.

By examining the behavior of other color-sensitive living creatures we could perhaps make color discriminations, though very clumsily. We would each have to take specially trained animals about with us, rather like seeing-dogs. But there remains the problem of training those animals. And how could they be properly trained unless the trainer could make color discriminations in some way or another? At best, it seems that from

the behavior of some animals we could know that there were some properties of objects that they perceive but which we do not.

We can sensibly suppose that there is no meaning-relation between wavelength of light and color; similar arguments and situations can be constructed for the other secondary qualities such as taste and smell. It seems open to us to make the meanings of the names of secondary qualities depend on characteristic responses of living creatures (and those responses can always be imagined removed). We would thereby make the characteristic response of the living creatures the criterion of the occurance of the secondary qualities. Also, in imagining that humans no longer respond to color, smell, and taste in the ways they now do does not require that we imagine something that is logically but not empirically possible; we can make a fair beginning at specifying the surgical operations required to remove these sensing abilities.

Now assuming that these sorts of operations were performed, say on our eyes, we would no longer be able to make color discriminations, and color words would fall into disuse and gradually be forgotten. Color words would no longer have use, and our abilities to get around in the world would be somewhat impaired, but we would certainly not be incapacitated. Also, no conceptual problems, questions of object individuation and objectivity, would arise. We might be able to distinguish balls as red and blue, but that there are two balls in front of one would still be quite evident. The secondary qualities can be imagined in this way to be eliminated from our knowledge of the world. I want now to show that nothing of this sort can be done for the primary qualities, and

that in this way they differ radically from the secondary qualities.

When an object has a primary quality, say some shape, we not only expect that the object will look and feel to be that shape, but that it will act as though it has that shape. Of course, colored objects act as though they were colored: they cause us to see them as having that color. Colored objects cause these characteristic reactions, but they are related, in virtue of their color, to few other events in, or facts about, the world. Sometimes the ripeness of fruit is indicated by color, but not always reliably, and not very regularly. Other connections between color and non-color properties of objects are just as unreliable as in the fruit example. The color of an object is, however, causally related to the properties of the surface of the object that cause it to reflect light of a certain range of wavelengths. The colors of objects are also causally related to their heat-reflecting and heat-absorbing properties. This sort of regular, causal connection has been discussed before, and arguments presented against there being a meaning-connection between color and wavelength; similar arguments could be presented against the color/heat-properties connection, since that connection is causally connected with properties of the surface of the object including but not limited to color. The relations between surface properties, heat-properties, and color are complicated, and most people know only the crudest of them, that black objects, other things being equal, absorb heat more readily than do light-colored objects.

When an object has a particular shape, there are a great number of connections between its being that shape and the ways it acts and interacts

with other objects. A square object won't roll, it has corners that can be used to make marks in some materials; square objects fit into square holes and not round ones, and so on. The list of connections between the shape of an object and how it acts is long, and other than saying that the object acts like a square object, there is no way we can enumerate all of these connections and characteristics ways of acting and interacting. The primary qualities all have this characteristic: a primary quality of an object will appear many times as the cause of or as the reason for the object behaving as it does. And it is because of the number and variety of these connections between the primary qualities of the object and other of its properties and ways of acting that we cannot sensibly suppose ourselves to consistently and persistently misperceive a primary quality. And likewise it is because of the scarcity of connections, and of the special nature of those that there are, that we can sensibly suppose ourselves to misperceive or to not perceive at all the secondary qualities.

Consider the case of a man who is not able to distinguish square objects from round objects. Let him have two objects at hand, one of which is thin, planar, and square, the other of which is a circular object of the same thickness as the square, and having a diameter equal to the length of a side of the square. They may both look and feel either square or round to the man, but they must look and feel to be the same shape.

The man's misperceptions have been limited to the squareness and roundness of objects. He does not misperceive other shapes nor other

primary or secondary properties. There must be objects in the world some of whose properties are not misperceived, else our ability to perceive has completely broken down, in which case there is indeed no way to determine, nor little sense in saying, that we are misperceiving. But aside from these difficulties, the parallel with the argument for the secondary qualities must be maintained, and hence the misperceptions will be limited to one or a few primary qualities.

Now what happens if the man tries to roll the two objects across the floor? One of them will roll and the other will not. What happens when he presses the two objects against his body, with the edges pressing against him? If the objects are perhaps one half inch thick, they will leave rather different indentations in the flesh. If he then holds them as before, and drags them across his skin, the sharp corners of the square will tear the skin, while the circle will not. The man will be able to find holes through which one of the objects will go but not the other. Tilting the objects sideways and stepping back, one will look rectangular and the other elliptical. If he uses the pieces in patching two identical, square holes in the wall of his house, assuming that the square object fits precisely, light will come through the holes around the circular object. Though it may take the man some time to collate all these data, he will know that there is a difference between the two objects that he perceives not as a difference in shape, but only as a difference in behavior, and from his experience should be able to find out what that difference is.

Similar things happen when size is the primary quality for which we propose a consistently misperceiving observer, and similar things happen with length, and with hardness. When we assume that someone can persistently misperceive a primary quality, we must assume that he misperceives a multitude of other characteristics of the world, which we cannot specify in advance. What misperceptions are required in order that the investigator not discover his original misperception depend on what tests he performs with the objects he is misperceiving. Thus in order to preserve our initial assumption, that the investigator does not discover that he is misperceiving, a rapidly increasing number of misperceptions must be allowed. But this contradicts our other original assumption, that just squareness and roundness were misperceived. Either the investigator discovers his misperceptions, or almost everything must be allowed to be misperceived.

We cannot sensibly suppose that an investigator consistently misperceives one of the primary qualities. We can suppose that one of the secondary qualities is consistently misperceived, or not perceived at all, and this constitutes the basis of the primary/secondary distinction. Because the distinction rests on the number of connections to be found between an object's possessing one property and its possessing other properties, primariness and secondariness allow of degrees, though there seem to be no properties which do hold a middle ground between primary and secondary.

Since the primary/secondary distinction rests on causal and conceptual connections among objects and properties, we can expect to find some

connections between the primary/secondary distinction and the simple/complex distinction.

If a property is a secondary quality, then it must either be a simple property of sense-mode S, or be a complex property of S, and be analyzable into simples of S. If this were not so, if a secondary quality could be a complex property P of S, and not analyzable into simples, then there would necessarily be a number of connections between an object's having P and its having other properties which are directly determinable in S; these other properties would imply P. And if there are such properties, then P cannot be a secondary quality, since we could not suppose that P was persistently misperceived without supposing that the group of properties which imply P-ness are also misperceived.

That this group of properties also be persistently misperceived may seem possible, but is not, because of the nature of the properties in question. If the complexity of such a property P is not analyzable into simples, then it must be analyzable into some group of properties which are themselves non-simple, and not analyzable into simples. Thus there will be a group of irreducibly non-simple properties which are interrelated: the complexity of any one of them will be explained in terms of the others. There is only one such group of properties, those whose analysis includes spatial state-descriptions of objects. The problem would be very different, and much more difficult, if there were more than one such group of interrelated, irreducibly non-simple properties.

I conjecture that if there is to be only one causal order, one set of interrelated causal laws, there must be only one group of interrelated,

irreducibly non-simple properties; and that if there are two such groups of properties, there will be two causal orders. But this whole problem is considerably outside the range of my present concerns.

The connection between being of a particular color and reflecting light of a given range of wavelengths is a specialized piece of scientific knowledge. And it appears to be the only systematic connection between an object's having some set of non-color properties and its being a particular color. It seems an open question whether this connection is implicative - that because an object reflects light of a certain wavelength implies (as part of the meaning of the color-word) that it is a certain color. If we ignore this connection, and do not take it as implicative - and it is characteristic of the secondary properties that it is possible and sensible to ignore the connection - then the property of being some color must either be simple or analyzable into other colors which are simple. It is because the connections between colors and other properties are few and are specialized and scientific, and because the analysis into simples is possible, that color is a secondary quality.

I shall now argue that if a property is simple, it must be secondary. If a property is tactually simple, then there are no other tactually directly determinable properties of the object that imply that it has P. (This argument, as will be seen, has to operate within some given sense-mode; I use the tactual sense-mode, but the argument needs only a systematic change of "tactual" to "visual" to apply to vision, say.) Now all primary qualities are tactually determinable, and hence are either directly determinable or indirectly determinable by the relation test. Hence if a

property P is simple - there are no tactually directly determinable properties which imply P - some non-tactual property or properties of the object could imply that it is P. But because the primary qualities are all tactually determinable, some non-tactual secondary quality or qualities are the only properties which could, if P is to remain simple, logically imply that the object has P. But if the implying properties are secondary, then the simple property P must be secondary. If, (i), there are no other properties which imply P, then P is secondary, and if, (ii), there are no properties other than secondary properties which imply P, P must be secondary, and either (i) or (ii) must hold. If (i) obtains, the simple to secondary implication holds, and if (ii) obtains, the implication holds also, since if the only property which implies P is secondary, it can be persistently misperceived, and hence P can also be persistently misperceived without generating any more misperceptions.

There is therefore an equivalence between being a secondary quality and being a simple property or a property analyzable into simples. This equivalence relation contains the truth in the common claim that the secondary qualities are dependent on, or are peculiarly associated with, some one or another sense-mode. If a property is secondary, then it is simple or analyzable into simples, and simple, or analyzable-into-simple, properties, in being distinguished as such, are placed in and belong to some one or another sense-mode.

Difficult problems arise when the question is asked: can a property be simple and belong to more than one sense-mode? I'm not sure how to answer, but will begin by setting out the problem. Consider a creature

who claims to have two sense-modes, call them X and Y, with both of which he claims to sense blue. Now can we, short of using physiological considerations, differentiate between the creature's X-ing blue and Y-ing blue? I see no way that we can so distinguish, so long as the property being X-ed and Y-ed is secondary. The only way, other than physiologically, to distinguish X-ing and Y-ing a property would be by linking the detection of some property P, which is claimed to be detected by both of the sense-modes X and Y, with some other property which can be detected by the creature only through one of the sense-modes. If this sort of link is made, then there are grounds for distinguishing the sense-modes, and grounds for distinguishing cases of X-ing blue from cases of Y-ing blue. But if the property P is secondary, as blue is, there will not be the required sort of detection links between P and other properties which cannot be detected by both sense-modes. And since there cannot be, therefore, secondary properties which belong to more than one sense-mode, there cannot be simple properties, either.

I do not know how to assess the strength of this argument, and distrust it somewhat. If the creature nonetheless claimed that X-ing blue and Y-ing blue are very different, we would be inclined to accept his claim. Perhaps in an experiment of this sort we could settle the problem; if one of the creatures has been Y-blind from birth, and if an operation is performed which restores his Y-sense, if he doesn't have to learn to Y blue, but Y-recognizes it immediately, I think we would want to say that X-ing and Y-ing are operations of the same sense-mode. If, on the other hand, the creature has to learn to Y-recognize blue,

I should think that we would allow that X and Y are different sense-modes. At any rate, the question of whether there can be a simple property belonging to more than one sense-mode depends on how the sense-modes are differentiated. And this question also illustrates the limitations of my approach. The learning-situation test seems to be a use of (3), the surrounding-conditions approach to distinguishing the senses. From all of this I think we can conclude that if the question had arisen in fact - if we could say both "I feel it to be green" and "I see that it is green", say - my approach, to distinguish the sense-modes through the features we become aware of through them, would not have been adequate. Only simple, or reducible to simple properties can cause this difficulty; irreducibly non-simple properties are detection-linked sufficiently to prevent the problem arising.

Any property which is tightly complex and which is not analyzable into simples is a primary quality. If the property P is tightly complex, there are other properties which are directly determinable and which entail P. This follows from the definition of a tightly complex property. If these directly determinable properties are not simple nor reducible to simples, then they in turn will each be entailed by some set of directly determinable properties which are not reducible to simples, and so on. Thus there will be a complex net of logical relations among those tightly complex properties which are not reducible to simples. And because this group of connections between properties spreads, and eventually connects many properties, the property P cannot be assumed to be persistently misperceived, since then all of the properties which could imply P must also be allowed to be misperceived. The reverse implication holds as

well: any primary quality is a tightly complex property of one or more sense-modes. Clearly if there are many connections between a primary quality P and other properties, as there must be if P is primary, then P is also tightly complex. Thus there is an equivalence between being a primary quality and being a tightly complex property of one or more sense-modes.

IV. Dispositional Properties

To describe a property as dispositional is to say that any object which possesses the property is disposed to do certain things under certain circumstances. I will investigate in this chapter the sorts of dispositionality a property may have, and the connections between sorts of dispositionality and the simple/complex and primary/secondary distinctions among properties.

Any empirical property P will be in some way or another dispositional; an explication of the property will be, either in full or in part, of a dispositional form. If P is an empirical property, the meaning of "P" will depend, at least in part, on how P-objects behave. Properties traditionally called dispositional are ones whose analysis is completed by specifying what the object will do in the appropriate circumstances, e.g., soluble substances will dissolve in some liquids. Though for a property like squareness we can give a non-dispositional analysis using spatial relations among spatial parts, a square object acts and interacts in certain ways because it is square - it manifests its squareness in causal interactions with other objects. It seems to me a consequence of a straight-forward meaning-empiricism that the meaning of "square" is explicated, at least in part, by pointing out the things that square objects are disposed to do. I don't think that such a dispositional analysis of squareness is exhaustive, however. "Square" has a meaning in Euclidian geometry which is not to be explained (in any straight-forward way) by pointing to facts about the world. There are also conceptual relations

such as "a square has four sides" which enter in an explication. My claim, that any empirical property must have, in part, a dispositional analysis, comes to merely that when we attempt to explicate the meaning of a property-word, we must, if the property is empirical, point to things that happen in the world - to things that objects (are disposed to) do.

I am not overlooking the distinction between saying that qualities are dispositional - e.g., solubility, and saying that something has a disposition to act in a certain way because it has some (possibly non-dispositional) property. When we try to explain what "the object is (approximately) square" means, we necessarily point out other characteristics of that object, e.g., if it's rolled across a flat surface it will bump. This characteristic and some others will be dispositions.

We may explain an object's having a certain disposition to act and react by noting other properties the object has. This does not bear on the question whether a given property is dispositional. Objects merely do act as they do, and when we ascribe properties to objects we are saying how they act. There may be complicated relations among these properties, so that part of the meaning of a property-word is contained in its conceptual relations with other property-words. But if we are to apply those property-words to the world, the application must depend on how objects do and may be expected to behave.

The sort of dispositionality that all empirical properties share cuts across the simple/complex and the primary/secondary distinctions. A color may be a simple property, and it is a secondary quality. To say that an

object is red means that it is disposed to produce a certain complex kind of reaction in humans and other color-sensitive creatures; but the object is not disposed, because it is red, to do anything else. The sorts of thing that a hard object, because it is hard, is disposed to do are not limited to producing reactions in humans and other living creatures.

What I am concerned to do is to distinguish between the dispositionalities of primary and secondary qualities. Also, the standard practice of describing as dispositional such properties as frangible, soluble, elastic, hard, etc., and as non-dispositional, squareness, roundness, etc., and something of the rational behind these practices, should become clearer. Within the group of complex primary qualities two sorts of dispositionality may be distinguished, the grounds for the distinction being the differing sorts of complexity of the properties.

To describe a property P as dispositional is to say that if an object has P, then it is disposed to do certain things under certain circumstances. Just because "do" is very general, this formulation is not particularly useful. "Act in certain ways" cannot be substituted for "do certain things" because sometimes what the object does is nothing. The absence of a response in the object when something is done to it may be important, e.g., when an object is described as unbreakable. Also, in certain circumstances an object's failing to act may be important: if one looks at a sheet of plain glass, it fails to cause the change of state colored objects characteristically cause in humans.

The formulation of what it is for an object to be colored goes as follows:

> Given an object and a human or other color-sensitive living creature, if when the creature looks at the object, the creature's state is altered in certain complex ways, the object is colored. Two objects stand in a certain relation: the creature is looking at the (colored) object. A color-response occurs in the creature; no response or change of state occurs in the colored object. The object is colored because it does produce, and is disposed to produce, a certain response in the color-sensitive creature.

The analysis of what it is for an object x to have a secondary quality goes as follows:

> If x has a property P, and if whenever x has relation R to a human or other P-sensitive living creature, a reaction S is induced in the creature, and no change of state occurs in x or in any other non-living object because x has P, the P is a secondary quality.

The analysis of the secondary qualities takes this form because the arguments which establish the primary/secondary distinction show that the secondary qualities are (i) peculiarly dependent on facts about humans, and to a lesser extent, other living creatures (the meanings of secondary property-words are dependent on the characteristic responses of P-sensitive creatures), and (ii) are conceptually unconnected (in the required ways) with properties other than a few other secondary qualities, and (iii) are causally isolated in the required ways; that some object x has a secondary property P is never a reason for x's actions on objects, except in producing the S-reaction in living creatures. The secondary qualities are causally isolated to the extent that no change of state in x or in any other non-living object is explained by x having P. If such a change of state occured, then a secondary quality P would not be causally isolated in the required way; it would be connected systematically with changes of state in objects, and with primary qualities,

and the presence of those primary qualities would entail P, and P would therefore no longer be a secondary quality.

An object which has a secondary quality P is disposed to produce in a human or other P-sensitive living creature a certain characteristic kind of response, and is not disposed to produce any kind of response in a non-living object. There is a meaning-equivalence between "having (a secondary property) P" and "being disposed to produce the S-response". A dye may change the color of a fabric, but either it was not because of the color of the dye that it acted on the object as it did, or what the dye did was not to act on the dyed object, but merely to spread itself through the fabric, the various particles of the dye retaining their color and coloring the fabric by their presence. In the first case the dye changes the state of the fabric, and alters its chemical structure. The color of the dye is not a reason which explains its action: its chemical composition explains why and is the reason why the dye acted as it did. In the second case the dye does not act on the fabric, but spreads itself on and through it. This second case is similar to the case of changing the color of a house by painting. The paint is of a certain color and is spread over the house, and the house is then of that color. We have perhaps changed the state of the house, but we have done so by interposing an object between us and the house. If the state of the house or the fabric has been changed, it has been changed by addition; and the addition is of material of a certain color.

That an object is square and hard can be a reason for its ways of acting and reacting. Properties which can be used to describe how objects

other than living creatures react and interact are primary qualities: if an object is hard, then it is disposed to resist changes in shape. But no set of secondary qualities imply anything other than (a) how humans or other P-sensitive creatures will respond, or (b) that the object has some other secondary quality. The secondary qualities are in this way causally isolated, since their presence does not imply anything about possible changes in state in any objects other than living creatures.

These claims about secondary properties may seems too strong. For instance, that I am warmer (in direct sunlight) in a black shirt than a white is explained by the colors of the shirts. What prevents this from undercutting my claims is that one has to say "a black shirt"; in a broad fashion the kind of object must be specified, since a very shiny and smooth black object will reflect heat more efficiently than a white shirt of a rough fabric. It is only for a given kind of material that the black/hot connection works. There is not a direct and unqualified connection between the two properties.

Someone might nonetheless argue that: everything else being equal, the black object will absorb more heat than the white. The answer is that everything else is not equal; the claim that the only properties in which the black and white objects differ is color (and heat-absorbing abilities) is false. Previously in the argument I had deliberately refrained from bringing specifically scientific consideration into use. A primary/secondary distinction established on scientific grounds is not the same distinction as the one I have tried to establish using well-known and non-technical connections between properties. But if the phrase "everything

else being equal" is used, then all the properties of the objects need to be considered. And if that is done, the connection found will be one between molecular, structural properties of the material and its heat-absorbing properties. The color/heat-properties connection needn't and doesn't always hold. It is possible to find (or make) materials which react to visible light by causing us to see some color other than black, and react to heat radiation, which is of a much longer wavelength, as a black body. A material whose reactions were reversed, so that it looked black, but with respect to heating-properties, acted not-black, could also be found or made.

Primary qualities are unlike secondary qualities in that an object, in having some primary quality, is disposed to act on and react to many sorts of object; the primary qualities are important in describing the interactions of living and non-living objects. The primary qualities may be characterized as follows:

> Let x and y be objects, P a property, and R a relation. Then, if x or y has P, and if x stands in relation R to y, and if as a result of Px or Py, and xRy, a change of state can occur in x or y or both, P is a primary quality.

There are no restrictions on the sorts of object x and y may be, and this is the major difference between the primary and secondary qualities. The primary qualities do not depend on humans or other living creatures as secondary qualities do.

Because an object has some primary quality it is disposed to act or react in certain ways. It may be disposed to resist change of shape, as is a hard object, or to return to its original shape after deformation,

as is an elastic object; or one object may be disposed to scratch another object and not be scratched. What an object may be disposed to do because it has a primary quality is not limited to producing reactions in living creatures. And this is how the primary qualities differ from the secondaries in the sort of dispositionality they have. The primaries may be given as reasons for changes in state of interacting objects neither of which need be living creatures. And this is why the primary qualities are those used in giving causal explanations and why the secondary qualities are causally isolated, i.e., they do not figure in causal explanations other than in explaining how and why living creatures are affected by some objects.

However, not all primary qualities are dispositional in quite the same way. If an object is square, it is disposed to act and react in a fashion characteristic of square objects - though this is not all that needs to be said in explaining "squareness". Any attempt to specify the ways of acting and reacting characteristic of square objects becomes a mere listing of kinds of interactions. When we try to describe the ways of behaving characteristic of square objects we either use "square", concepts which are analytically related to "square", or offer merely a list. The spatial properties generally seem like this, and I think that this is a reason for holding that we do not differentiate spatial properties solely through the behavior of objects which have them. We use spatial relations among spatial parts of objects to differentiate the spatial properties.

In contrast with the spatial properties, a property like hardness can be characterized, and is properly characterized I think, solely by means of reference to certain dispositions of objects. That an object is hard means that it is disposed to resist changing its shape.

The spatial properties are all tightly complex. Therefore for an object which has a spatial property it is always possible to specify certain characteristics of the parts, and relations among the parts, which entail that the object has the property. The characteristics and relations must themselves be directly determinable of course. This same sort of treatment can be given hardness, elasticity, malleability, etc., but what distinguishes the spatial properties from these properties is that the spatial properties do not, and these other properties do, involve relations in time among the parts, such as a change in the characteristics of a part, or a change in the spatial relations among the parts.

I propose to call "weakly dispositional" those properties of objects, such as spatial properties, which do not involve relations in time among its parts. Those properties which do involve relations in time, such as hardness and elasticity, I will call "strongly dispositional". Thus, that an object is hard, frangible, elastic, etc., means that it is disposed to exhibit, under the appropriate circumstances, certain relations in time among its parts. The strongly dispositional properties are those which have traditionally been called dispositional. Conditional sentences are necessary in adequately explaining strongly dispositional properties, since if an object has some strongly dispositional property P, it is not the state of the object at some time that is characteristic of an object possessing P, but what it is disposed to do under appropriate circumstances - if the appropriate actions are performed on it. Thus: if an object has some strongly dispositional property, and if the appropriate action is performed on that object, it will react in certain ways.

I will briefly examine the strongly dispositional property hardness, both for illustrative purposes, and because it will provide an opportunity to investigate the property to see whether, as has sometimes been claimed, hardness and softness are more nearly secondary than primary qualities. Locke, for instance, gives hardness and softness characteristics that place them in an uneasy middle ground between primary and secondary. The following is a quotation from Locke.

> "Solidity is hereby differenced from hardness, in that solidity consists in repletion, and so an utter exclusion of other bodies out of the space it possesses; but hardness, in a firm cohesion of the parts of matter, making up masses of a sensible bulk, so that the whole does not easily change its figure. And indeed, hard and soft are names we give to things in relation to the constitutions of our own bodies; that being generally called hard by us, which will put us to pain sooner than change figure by the pressure of any part of our bodies; and that, on the contrary, soft, which changes the situation of its parts upon an easy unpainful touch."[4]

Locke's use of "figure" is interchangeable with my use of "shape"; his use of "solidity" is similar to, though perhaps not interchangeable with "impenetrability". According to Locke, then, that a body is hard means that it does not easily change its shape. Locke wrongly restricts the applicability of "hard" to bodies of sensible bulk, by which I presume he means touchable or visible bodies. Except for that clause, which seems arbitrary on any account, his explication of hardness, with minor qualifications, seems correct: "but hardness, in a firm cohesion of the parts of matter, so that the whole does not easily change its figure". By limiting the applicability of "hard" to bodies of sensible bulk, Locke leaves us no way to talk about the relative resistance to change of shape of microscopic bodies. Surely this is unwarranted, and

[4]Locke, An Essay Concerning Human Understanding, Dover Publications, Inc., New York, 1959, Vol. I, Book II, Chap. IV, p. 154.

surely we can talk sensibly about the relative softness of an amoeba and hardness of a microscopic bit of metal.

One other point on which Locke might be wrong is the phrase "in a firm cohesion of the parts of matter". If he intends this as a causal explanation, it's misplaced. In explaining what it is for an object to be hard we just don't need to give any explanation of why objects are hard. Once that clause has been removed (if Locke did intend it as a causal explanation), hardness is simply resistance to change of shape, and is purely dispositional. A hard body is one that is disposed to resist changes in shape.

Locke correctly points out that the degree of hardness of the human body is a reference point, a standard which serves to establish a central point of the scale of degrees of hardness which we commonly use. But there are other scales of hardness; we say that a faucet washer has gone hard, meaning that it is harder than a faucet washer ought to be, even though it was quite hard already, relative to our bodies.

The most widely used scale of degrees of hardness is indeed that established with respect to the hardness of the human body; but because this is so does not mean that hardness cannot be found in bodies which are too small to be touched or seen. Hardness is not relative to human characteristics (and characteristic responses) in the way color is. But even on Locke's account, hardness is more nearly a primary quality than a secondary. That an object is hard means that it does not easily change its shape. There are many ways in which the shape of a body can be altered, and if the body is hard, it should resist such a change of

shape whether or not it is a human body engaged in the shape-changing activity.

The strongly dispositional properties generally are of the sort that when an object has one, it resists to a greater or lesser degree some particular kind of change of state. In the case of hardness, elasticity, and malleability, the change of state is a change in the arrangement of the parts of the object. In the case of stickiness, what is resisted is a change in the arrangement of two bodies with respect to one another.

The conditions for application of strongly dispositional properties must include a specification of the context in such a way that what is important is that certain kinds of changes either do or do not occur, for certain kinds of reasons. An object is not sticky because another object cannot easily be separated from it when the two are nailed together. Nor is an object heavy when it is very hard to lift because it is nailed down. Hardness and elasticity require that spontaneous change of shape be barred as having nothing to do with degree of hardness or elasticity. And changes of shape for certain other sorts of reasons must also be barred. That lumber warps as it dries says nothing about the hardness of wood.

One is tempted to explain this limitation on how the change of shape may be brought about, if the result is to tell us anything about the hardness of the object, by saying that we take as a paradigm the human action of pushing on an object. And perhaps this was what Locke had in mind when he discussed hardness. The answer is simpler, I think, and lies in the crude distinctions we have always made between cases where objects interact by pushing against one another, and cases where whatever happens

is not obviously of that sort. This way of viewing the grounds of the distinction seems to include the first way, since human bodies can push against other bodies, and in general can interact with other material objects in all those ways taken as characteristics of material bodies.

When an object has some strongly dispositional property it is not sufficient to say that that object is disposed to react in a certain way when acted on in a certain way. The absence of a reaction in the object may be important; this point was discussed earlier. But because an object has some strongly dispositional property, we expect that under appropriate circumstances and with the appropriate sort of action performed on it, it would react in the proper way. If an object is deformable, then there are some sorts of action that will deform it. And when we compare objects with respect to deformability, we do so by determining that an action which will deform one object either will or will not deform the other.

Only changes in shape brought about by the proper sort of action will be changes of shape which bear on the degree of hardness of an object. A change of shape does not indicate anything about hardness unless it has been brought about by one object pushing against another. And similarly the absence of any change in shape does not indicate anything about the hardness of an object unless the appropriate deforming action was performed on the object and it was not deformed.

With this sort of restriction on when the change of shape of an object is related to its hardness or elasticity, those properties are clearly primary, and are not dependent on properties of the human body.

A colored object in virtue of being colored can act on color-sensitive creatures. A hard object, in virtue of being hard, can act characteristically on all sorts of objects. And because an object is a particular color is not a reason for its reacting as it did to some action performed on it. It was previously argued that simply to produce color-changes in an object was not to act on it. Thus there can not be cases in which the action which is performed on an object causes a reaction because the object is colored. By contrast, because an object is hard rather than soft explains why it was deformed only slightly when I squeezed it. It reacted; a change of state was brought about by an action performed on it, and that change of state occured because the object had the strongly dispositional property of being hard.

The sense of touch gives us information of the interactions of our bodies with other objects. And the sort of information it gives is mainly information about primary quality changes in our and other bodies. In respect of primary quality state changes, the same sorts of things happen to us as to other objects.

V. Concluding Remarks

Why are there few tactual simples? And why are those tactual simples which there are relatively unimportant? When we say an object is greasy-feeling we are not saying that it is greasy. Our phenomenological interest is here purposely separated from our interest in what we may expect from the world. I may be giving you useful information if I tell you that the sidewalk is greasy. But if I tell you that this table-top is greasy-feeling (and not necessarily greasy, or even particularly slippery - there are such materials), I've pointed out something that may well be nothing more than a curiosity.

Since a secondary quality must be completely analyzable into simples, these questions are also about the relative unimportance of the tactual secondary properties. Is it merely that we have not developed and used property names for a number of tactual simples? Or are there reasons, practical or otherwise, which limit in number and importance the tactual simple and secondary qualities?

Warmth seems the most likely, of those properties which are held to be tactual, to be both secondary and important. Locke, at least, thought that warmth was a secondary quality, and therefore that it was a property of objects that was relative in some way to, dependent somehow on, the characteristics of humans. There are difficulties here; we do speak of sensations of warmth, whereas we are not so ready to speak of sensations of squareness. But this does not bear directly on the question whether warmth is secondary. With "warm" goes "warmer than", and hot things are just somewhat warmer than warm things. Heat can be transferred from object

to object, so that by turning on the electric blanket, the bed becomes warm, and not merely the blanket. Objects, if warmed enough, will either burn or melt; by the application of heat, primary-quality changes are induced. Warmth is consequently not a secondary quality. There are fewer connections, for warmth than for other primary qualities, between an object's being warm and the ways it may be expected to act and react. But of those few, communicability and melting or burning seem sufficient to give warmth primary quality status.

If warmth is a primary quality, then it must be a complex property. And it is a tactually complex property according to the definition of "complex" I use. There seems to be a difficulty here, since we do speak of sensations of warmth. Without attempting to give any explanation of "sensation", I will state that a sensation of warmth is something we have and objects don't have, and that warmth is something that objects and we can both have. So to say that a property is simple or complex does not say anything at all about a sensation, if there happens to be such, that has the same name as the property. Warmth is not a simple property, and that somehow our knowledge of warmth in objects is connected with the sensations of warmth which we have does not bear on the simplicity or complexity of warmth.

But even though talk of sensations does not have a place in discussing the conditions that make a property simple and secondary, the character of our sensing abilities clearly does have a place. Some objects - colored objects - act on (color-sensitive) creatures in ways quite unlike that of any other interactions among objects. In particular, our eyes are sensitive to certain characteristics of objects, and through them colored objects

act on us in ways that have little or no connection with the ways that colored objects act on non-living, non-color-sensitive, objects. This is where we can see that though warm objects cause in us a sensation of warmth, there is no connection between there being sensations of warmth and whether warmth is primary or secondary. An object, because it has some property P, may cause us to respond in certain characteristic ways, but if our responses are consistently connected with responses that that object, because it is P, causes in other objects, P is not secondary and is not simple.

If a property P is secondary, then there are few connections between an object having P and its having other properties. For color this separation from other properties is achieved through the special sensing abilities of our eyes. But colors are visual simples, and tactual simples are not simples (and secondaries) because of any specialization of sensing ability in the sense-organ. The separation of the tactual simples from other properties is achieved by a way of speaking which carries an implicit disclaimer of connections. We say "the thing feels glassy"; and it is correct to say that the thing feels glassy whether or not it is glassy, i.e., is made of glass. The feel of glass objects has been taken as a paradigm, and a kind of feel named after the material. And it is because of the way we use the expression "feels glassy" or "is glassy-feeling" that the object's having the property of being glassy-feeling implies nothing about other properties it may have.

In the preceding discussion, the conditions were presented which a tactual simple and secondary property must meet. Tactual simples have

achieved that status because of implicit disclaimers; because of the way we speak, there are certain tactual properties that an object may have which do not imply anything about any other properties of the object. The visual simples, color, for instance, are simples for different reasons than are tactual simples. The difference is important.

In the tactual sense-mode, our entire body surface can act as the sense-organ. Therefore, if there is to be a tactual secondary property which is not so because of the use of implicit disclaimers, there must be some property of objects to which all parts of our bodies are sensitive, but which does not figure as the reason for the character of an object's interactions with other, non-living, objects. There must be no connections between an object possessing the property of affecting all of our bodies, and its possessing other properties. If our bodies were sensitive to such a property, we would have radically different sensing abilities than we do have. We would be able to detect by touching a property that was manifested in no other sort of interaction among objects. I don't think that the possession of such sensing abilities would have caused any significant difference in the way we consider ourselves, or in the way the sense-modes are commonly distinguished. Consideration of the lack of such tactual sensing abilities merely serves to set off the specialized nature of the sensing abilities of our eyes, ears, nose, and tongue. Our eyes, ears, nose, and tongue make us sensitive to properties of objects from which non-living objects are causally isolated.

For these reasons there are few tactual simples, and those, unimportant. For there to be important tactual simples, our bodies would have to be sense-organs with specialized sensing abilities like our eyes and nose. Our bodies are not this sort of specialized sense-organ, and the tactual sense-mode is unique among the sense-modes in not being dependent upon some specialized sense-organ.

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