James K. Feibleman

FULL CONCRETENESS AND THE RE-MATERIALIZATION OF MATTER

We have been going through a period in the philosophy of science in which it has been dominated by the theory of the dematerialization of matter. From Eddington in 1927 to Hanson in the present day, this theory, in one formulation or another, has been maintained. Its adherents suppose that matter upon examination can be resolved into mental constructs of every description, from organized sets of sense impressions to mathematical equations. The idealists are so dazzled by the conditions under which the mental recognition of the extra-mental world occurs that they end by doubting the genuineness of the extra-mental world. But there are reasons to suspect that the idealistic interpretation is not the correct one, and I shall attempt here to present (though not to prove) the counter position. The materialist considers the extra-mental world genuine, but, as we shall see, it is not simply the case of an old materialism confronted with new evidence by the idealists. There is evidence for a new materialism as well. Thus what we

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have perhaps is an ancient controversy under fresh guises, a new idealism confronted by a new materialism.

The modern philosophers of physics who advocate idealism do not have things all their own way. Some physicists support them, but others support their opponents. The controversy is carried on between the physicists themselves without reference to the philosophers.

In the physical theory the proponents of the Copenhagen interpretation of quantum mechanics, as advanced by Bohr and Heisenberg, are countered by the interpretation advanced by Einstein and de Broglie and defended by Bohm and Vigier. The former is idealist and subjective in tone while the latter is materialist and objective. The advocates of the Copenhagen interpretation argue that no formulation of what constitutes the real world so far as it concerns quantum constituents can omit the instrument by means of which the observations and calculations are made. There is

> a subjective element in the description of atomic events, since the measuring device has been constructed by the observer, and we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning.[1]

Heisenberg has in all fairness stated equally well the position advocated by his opponents.

> It would, in their view, be desirable to return to the reality concept of classical physics or, to use a more general philosophical term, to the ontology of materialism.[2]

Obviously, all materialists, formal materialists as well as other kinds, would have to oppose the Copenhagen interpretation. Elsewhere I have endeavored to argue in favor of the opponents of the Copenhagen interpretation,[3] but I shall not undertake to do so here. For present purposes it will be more useful to show that current conceptions of matter are more consistent with the

[1] Werner Heisenberg, *Physics and Philosophy*, Harper and Brothers, New York, 1958, p. 58.

[2] W. Heisenberg, *op. cit.*, p. 129.

[3] "The principle of indeterminacy re-examined," *Ratio*, vol. III (1961), p. 133-151.

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realist interpretation. We have learned a lot in recent decades about the composition of matter, and what we have learned about it does not lend aid comfort to the idealists. We can see this particularly (I) in the concept of mass, (II) in a reconstruction of the classical interpretation of matter in the light of modern physics, (III) in the manner of the survival of the forms, and (IV) in the properties of matter which are disclosed at micro-levels.

I

Traditionally the concept of mass supported realism. By mass we understand that a force applied to a body produces an acceleration proportional to the force. But both the force and the body can be shown to have been operating in independence of human agency or observation. If a body be released at the top of an inclined plane by a timing device set for a period when no observers are to be present and allowed to strike against a spring attached to a measuring recorder at the base, and if the recorder shows a certain weight of impact was impressed upon it at that time, it can hardly be argued that these events are functions of the observer's mind. Matter has the property of remaining at rest or in uniform motion unless acted on by an external force (Newton's First Law); and its acceleration has to be proportional to an applied force (his Second Law).

In modern versions the weight of a body varies with its movement. The entity which remains unchanged during the changes in weight (the mass) is the inertial force. Weight is the force of gravitational attraction and is such as would produce an acceleration in a free body. Thus mass has been associated with force, which has become a property of matter; and mass has become the measure of that property in the case of a particular body. Thus there has been a shift in mass from an irrefrangibly static affair to one inevitably associated with its dynamic equivalent.

Matter in the physics of the seventeenth to the nineteenth centuries was subject to the external forces of motion and gravitation. The only internal force was that of inertia. Now in modern physics other forces have been added, electromagnetic and nuclear. In addition and of equal importance is that matter

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itself can be transformed into force. The name of this force is energy. But energy in the new conception is not unformed. It must be approximately equal in amount to the matter transformed.

The static and impenetrable matter of classical physics has been replaced in modern physics by a mass and energy which are interconvertible. Both mass and energy are conserved in 'events' according to a principle of constancy which allows for materialization and dematerialization only by means of the consequent production or destruction of an equal amount of energy. But if this is the case, then we are dealing with something real, something objective and determined by considerations not limited to our instruments.

The substantive nature of energy is dramatically illustrated by the recent discovery of the plasma state. Electrically charged gases consisting of ions and excited electrons constitute the most prevalent form of matter in the universe, more prevalent by far than solids or liquids or gases, a state which could perhaps be better described as one intermediate between matter and energy. The plasma state carries the epistemological independence of matter into the energy state.

There are three important conclusions to be drawn from this radical shift in the conception of matter.

The first is that matter is independent of our observations if it is interconvertible with energy. The laws governing the interchange are themselves immutable and not subject to shifting frames of reference. Something real underlying the transformations is undoubtedly called for, a substance even though not a substance in the old sense but one conformable with the newly discovered properties. Matter becomes inertial substance and energy kinetic substance.

The second conclusion is that energy relations have a dynamic and irrefrangible effects upon our bodies (among others) as well as upon our minds. Thus the objectivity of energy is an inescapable datum in the evidence for the independence of matter.

The third conclusion returns us to the general theme of this study. If matter can be transformed into energy, and energy itself has a certain structure, as quantum mechanics would seem to indicate, then matter too being only another condition of energy must be structured. And structured matter is informed matter,

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matter whose composition itself is made up of forms. But this apart from the degree of its reality is no different from Plato's and Aristotle's analysis of it. A matter made up of forms has its own properties and cannot be dismissed merely as though it were a matter made up by minds.

II

The separation of forms from matter was originally the work of Plato. He wished to call attention to the permanence of the forms, and he did so by distinguishing them from the matter in which they are found. Forms recur in the way in which singular and individual material objects do not, and their recurrence is certainly a fact which needs to be accounted for. Plato accounted for them by assigning to them a separate domain of being which is non-actual, as contrasted with matter which exists as a condition of being which is actual.

But in separating the forms from matter he may have gone too far, as one always seems to need to do when calling attention to a neglected aspect of reality. For he assigned most of the reality to the forms and left only a little for matter. Aristotle's aim was to repair the damage, nothing more, and to restore to actual existence the reality which seemed to have been removed from it in emphasizing the superior reality and permanence of the forms. Plato definitely made the identification of reality with permanence, and he failed to recognize that such an identification would require an equal reality for matter even if not for specific material objects.

Aristotle endeavored to repair this damage also by his emphasis on the reality of substance. If matter is always individual and substance is what is individual, then substance is the individual side of matter, a condition which can always be claimed for it. Every individual is different from every other individual and no individual survives as an individual, but the individuality of individuals, the fact that every piece of matter has the substantial qualification that it is individual, is a permanent condition and so represents a kind of endurance even thought a different kind from that of the forms.

If we accept Aristotle's version of the association existing be-

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tween matter and the forms, would this necessarily exclude Plato's interpretation? Perhaps Plato overstated the case for the separation of the forms from matter, but then, too, perhaps Aristotle overstated the case against Plato and for the exclusive interdependence of the forms and matter.

The understanding of forms might have gone forward much more quickly were it not for institutional dogmas. Religion settled for an official interpretation which precluded further investigation for some centuries. Then an unofficial but none the less rigorous philosophical version of empiricism delayed the solution by turning the investigation in a tangential direction. The complicated fact that the forms of matter can be approximately reproduced in mental images (which are themselves forms in matter but in quite another way) served to confuse the issue and divert the inquiry. Thanks to the logic of Frege and his followers and to the philosophy of Peirce, Whitehead and their followers, we are returning to the investigation of the forms of matter as they exist apart from their reflection in images.

We emerge from the consideration of Plato and Aristotle with two salient propositions: from Plato that the permanence of the forms indicates their separate reality, and from Aristotle that the permanence of substance indicates a similar degree of reality. If we could account for the permanence of the forms within substance, we could reduce the two domains to one, which even for a Platonist would have to be regarded as a desirable gain.

Aristotle endeavored to provide for this contingency also with his distinction between the potential and the actual. It comes to this, that potentiality is possibility in a material object: what it could be but is not and what it could do but does not. Actuality by contrast is what the material object is and does. This is all very well, and no doubt true, but does it get done what we need to get done, more specifically, does it account for the survival of the forms?

In organisms no doubt it does. The biological distinction between dominant and recessive characters carries the same functional distinction. There are elements within the organism which may remain recessive yet be transmitted through the genes and turn dominant only in members of a remote successive generation. In this way the permanence of the forms is accounted for success-

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fully. But what about the fate of the forms in lesser organizations, in physical and chemical objects, say? Can their permanence be accounted for with equal success, and if so how?

Let us consider some of the forms at these empirical levels. Any of the elementary particles will do, any naturally occurring chemical elements, hydrogen ions, say, and ferrous oxide. (It is significant perhaps that we can name classes of objects only by referring to their forms.) How are their forms transmitted from one generation of such objects to the next? Or are they? If not—and we certainly have to consider this possibility also—then how can we account for that recurrence of the physical forms which their similarity indicates? What conditions account for the fact that there always seems to be hydrogen ions and iron in the world?

III

The materialist position is stronger and the idealist correspondingly unnecessary if we can account objectively for the survival of the forms in matter. There exists no satisfactory explanation of the origin of hydrogen atoms beyond what is offered in the "big bang" theory, the origin of the solar system from a central point some 13 billion years ago. We start, then, with the hydrogen atom. Due to the events in their neighborhood they are either combined into helium atoms or they are stripped of their electrons to become ions. A very large number of further encounters of lesser combinations of atoms and molecules can account for the earth and also for the production of ferrous oxide in the earth's crust.

The problem then of avoiding excessive objective idealism in requiring a permanent separability of the forms from matter in order to preserve them hangs upon being able to account for the recurrence of the physical forms with no apparent connection between antecedent and consequent instances. It is easy to account for the reproduction of organisms but inorganic forms do not behave in the same way. Circles do not give rise to other circles, and squares do not generate squares. And while hydrogen ions do not give rise to other hydrogen ions we do not exactly have to introduce a second ontological domain in order to account for them.

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We can account for them purely in terms of accidental encounters together with the laws governing the combinatorial results of such encounters. The second domain can be reserved exclusively for logical entities, such as circles and squares. What we have in biology, namely, organic replication of the forms, does not always exist at the physical level, though it does sometimes, as with crystals.

Perhaps the solution can be arrived at by coming at the problem from another perspective. The problem itself may have been occasioned by the habit of looking at material objects only from the perspective of their actual forms, only, that is, by assuming that every material object has one, and only one, form. The identification of types is nothing more nor less than the recognition of that stage in its development which energy has reached. Matter as we now know is an equilibrated form of energy, and the succession of forms as the equilibrium is upset marks off the stage in its changes.

The essential point is this, that the form of a material object is the class to which it belongs as that class exists in the material object itself. For the class exists in two ways: in the material object and apart from the material object. When it exists apart from the material object we call it a logical object (for which Plato claimed a superior kind of being). But in fact the two kinds of existence of the class can be identified: it is the same logical object whether in the material object as the class to which it belongs as a whole or apart from the material object as the class to which it belongs as a whole or apart from the material object as the class to which other and similar material objects belong.

If we consider the equivalence of form and class then is true of it as a whole, but also it has parts which belong to classes. Elsewhere[4] I have tried to show that a material object belongs to classes in two different ways. There is a class to which it belongs as a whole, and there are classes to which its parts belong. (Each material object can belong to one class only but its parts belong to many classes since each part belongs to a class separately). Dobbin, the brown horse, is the name of a single object. It is a mem-

[4] "Material Objects and the Reference of Signs," *Synthese*, XV (1964), pp. 424-35.

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ber of the class, horse, and one of its properties is a member of the class, brown. It has other properties which are equally members of classes. What holds the properties together is the kind of resistance we have come to associate with substance: the individuality of the occasion for the association of certain properties in a given date and place.

A difficulty arose because some forms can be represented abstractly (and so considered separately), such as geometric forms, while others, such as organic forms, cannot. Forms which can be represented abstractly can be manipulated freely. "Circle" is easier to manage than "man." A diagram of a circle is a familiar object, but what could a diagram of a man be? Similary with all abstract relations, these are relations which experience has shown are representable. Abstractions seem to be "empty generalizations" only because of the absence of the concrete objects represented by them. The greater the number of properties the more abstract representation is needed. Objects absent in space could still be actual objects, as is the case with remote objects. But objects absent in time could only mean possible objects, objects in the past or future. Abstraction are classes of concrete and individual material objects the majority of which are treated *in absentia.*

IV

The program of readjustment to the situation in the physical world as modern physics has disclosed it calls for retaining within matter Locke's secondary as well as his primary qualities. Democritus and Locke after him divided up the classes of parts and considered some indigenous and others borrowed, the indigenous qualities being the physical properties, such as mass, density and dimension, and the borrowed qualities being the sense qualities such as color, smell and taste. The latter are however physical properties also, as the existence of micro-levels attests; and so if the borrowed qualities are in the same condition as the others we arrive at something approximating what Plato knew as sensible objects and what Aristotle knew as primary substance. It could be called "full concreteness," meaning the restoration to matter of all its potential as well as its actual properties.

We are no longer dealing with matter only as we encounter it

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at the level of gross common sense, which we may call the meso-level. For in addition there are the micro-levels, the levels of the atoms and its nucleus, and the macro-levels, the levels of the stellar systems and the galaxies. The micro-levels are studies by physics and the macro-levels by astronomy. The information obtained from ordinary observation is to be taken seriously as a partial description of the meso-level. But analytically there are micro-levels below. Reality, which in the definition adopted here calls for equality of being, cannot be completely described without including descriptions of all three levels.

It is the last of these levels which will chiefly concern us, the micro-levels. They are the most readily accessible of the levels other than the meso-level. Plato was talking about a macro-level of logical entities and Aristotle about the meso-level. We are badly in need now of a Plato of the micro-level. We shall need to recognize among micro-levels analogues of some of the properties we know from our experience to exist within the meso-level.

The distinction made by Aristotle between actual and potential forms holds for the micro-levels. According to Powell a particle is not to be understood as an irrefrangible entity, like the Greek atom, but rather as being continually transformed into other forms and then back into its previous form again.[5]

Matter at the micro-cosmic level is not solid but porous. At the meso-cosmic level it is solid, but at the micro-cosmic level it contains more space than substance. So far as it is substantial it consists in an equilibrium of forces. But this does not mean that it dissolves into nothing or into the mathematical formulations by means of which the equilibrium of forces is expressed.

The old materialism allowed as real only what was disclosed by the unaided senses, only what could be touched or heard or seen. But now we have instruments to extend the senses and mathematics to express and interpret what we can learn in this way. And the result is that matter stands revealed as much more subtle and complex than the older materialism had supposed. All of the properties which on the basis of the old materialism were excluded from matter can on the basis of the new materialism be re-

[5] "Why should We study High-Energy Nuclear Physics?," *Nature* (1964), n. 204, pp. 421-425, esp. p. 422.

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placed in it. These properties, formerly excluded, are of two kinds. In the first group are the forms and in the second group the qualities. The result of the new version of formal materialism is that nothing, that we can know on the basis either of meso-cosmic observation or of micro-cosmic experiment and calculation need be excluded from matter. Matter stands then as the repository of all of being, both of what-is and could be but is not, and of what was and what will be.

As to the forms, what we ordinarily encounter is a resistant bit of matter of a certain form. We think of this actual form as its form and of its other properties as being undefined and indefinite qualities. But what gives a material object its solidity is the myriad of potential forms masked behind its actual form. The stereoscopic property arises from the mutual adjustment of compossible forms.

The form of an object is what it appears to be from the perspective of its function, of the events in which it reacts. Any isolable material entity may be said to be multiformed. That is to say, it is capable of taking part in many types of events and thus of many functions. Observers are apt to identify an object with the type of event in which it is functioning with that function. This is legitimate only for that date and place and the context of matter and energy to which that date and place submits the object. But for other dates and places, and other substantive contexts other functions would be elicited, and there would be an exchange of an actual form with a potential form, thus changing the function of the object while retaining for it the same number of potential forms.

Persistent material objects are divided into smaller and larger localized regions in which energy interchanges take place between material entities. Matter thus proves to be a name for slow processes and energy a name for fast entities. With respect to its own constituents a meso-cosmic bit of matter at the meso-level constitutes its own substantive environment.

It is possible to show that material objects probably have sense qualities which are yet unavailable to the unaided human senses. Consider for example the range of sounds a dog hears which men cannot. The assumption that qualities exist only within the limits of the range available to human ears goes against all the criteria

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of consistency. All material objects we know about at the macro-level have such qualities; what grounds other than the lack of observations warrant us in denying them to material objects at micro-levels? This would leave us in the position of asserting that material objects have the status of non-sensibles at micro-levels while remaining sensibles at meso-levels, in short that qualities do not exist if we cannot sense them.

It is true, of course, that nobody has had any experience of the qualities of material objects at micro-levels. To be detectable at the micro-level would mean to have an impact on sense organs (or their equivalent in instruments) more sensitive than are yet available to human organism. The burden of proof, therefore, remains with those who contend that qualities exist at the micro-level akin to what we know as sense qualities at the meso-level. Yet all the indirect evidence points in that direction.

There is a continuity of structure at all integrative levels. At a certain point in the hierarchy qualities begin to appear, and then at another point they disappear again. Qualities are detected by means of their accompanying radiation; colors for instance have their corresponding wave-lengts. Qualities are bonds between dissimilar through an ongoing process of affection, and this is equally true whether it is of wholes or of parts. Relations are bonds between similars through their respective membership in classes, again whether of wholes or of parts. The evidence of radio astronomy increases the likelihood that matter at macro-levels gives off radiation as much as it is known to do at micro-levels. It seems easier to support the theory of qualities at the macro-level. But the inference that what is true of two of the three levels might also be true of the third persists.

There is no reason, then, to suppose that the de-materialization of matter is called for by recent developments in physics but precisely the reverse. Full concreteness requires the re-materialization of matter. Its steroscopic properties include all those attributes of which we have found it to be possessed. Its interconvertibility with energy demonstrates a capacity for activity and the exercise of force, that activity which on the part of man Hume asserted to be the greatest subverter of scepticism.[6] What we

[6] Hume, *Inquiry concerning Human Understanding*, XII, Part II.

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learn about the nature of the real external world we learn despite the limitations imposed on our knowledge by the methods whereby we attain to such knowledge, and surely not because of those limitations. And it is useless to consider the limitations themselves the chief part of what we do learn. In short, far from demonstrating that matter as such does not exist apart from the perceiving subject, it would be easier to defend the contention that the perceiving subject does not exist except as a comparatively recent and hastily assembled configuration of material atoms sufficient to provide a loosely organized and highly temporary perspective on localized regions of the material world.

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