DISCUSSION: PEACOCKE'S "REDUCTIONISM"

by Mary Hesse

One of the misleading features of the problem of reductionism is that physics has been very fortunate in its Newtonian origins since it evidences reducibility of the following kind. If we are considering two Newtonian particles 1 and 2, then there are no ontological problems about them: They have one property, mass, and there are force relations between them which vary with distance. In Newtonian gravitational theory, if we now add a third particle 3, then in the new system 1, 2, 3 the forces between the masses are superposable—that is, how 1 affects 2 is added to the effect of 3 on 2, without the presence of 3 in any way altering the effect of 1 on 2. This is the principle of additivity of forces, which encourages an extreme ontological reductionism, for one can always reduce a complex system to the particles and the relationships between any pair of particles.

Now many of the questions about reductionism are about whether that scheme is adequate even for physics, let alone the sciences of higher-order, more complex systems. Take the well-known example from quantum physics: the two-slit experiment. Here a stream of particles (e.g., electrons) is directed at a screen in which there are two slits, and those that pass through the slits cause scintillations on a second fluorescent screen, placed parallel to the first screen. The presence of slit 1 affects what happens at slit 2: If 1 is closed, the scintillation produced by a particle passing through 2 is not the same as if 1 is open. Superposition of events at the first screen with 1 or 2, but not both, open does not yield the events at the screen when 1 and 2 are open together. That is, in quantum physics the more complex situation is not reducible to the simpler in the way that Newtonian classical physics allows. There is (in the two-slit situation) a triadic relation which involves more than the three diadic relations between the pairs. In more complex molecular biological systems, one could also possibly have these higher-order relations.

I think Michael Polanyi's comparison with a machine does not help much here, for it seems to me doubtful that any higher-order relationships of this kind are involved in a machine, however complex, whose working is describable by Newtonian mechanics. Merely the fact that a machine is designed by man and would not be found in nature does not in itself in any sense show that the relations involved in it are or are not reducible to physicochemical relations.

But I do think there are physicochemical cases in which reduction is impossible, not because of the presence of some mysterious entity or substance but because the properties and relations of the units at a lower level may not be

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sufficient to account for their properties and relations at a higher level. These higher-order relations may "emerge" at this higher level in the quite innocuous sense that if one needs three particles for a triadic relation then triadic relations cannot occur with only two particles. This is the kind of case to which biologists should appeal—where there is logical irreducibility and no amount of greater knowledge will remove it.

It is in these cases, then, just a contingent fact about the world that relations occur which are logically irreducible, and no future research will bring about reduction if this is so. Whether it is so is for biologists to tell us by logical analysis of the types of relation presupposed by their currently accepted, best theories. The entities of a complex system may indeed be atoms and molecules (à la Crick), so that one can be ontologically reductionist vis-à-vis these units but not be ontologically reductionist about the kind of relations between them in higher-order, complex systems. This distinction is not often made.

With reference to consciousness, I would want to say that there is no a priori interest, on behalf of religion or humanism, in insisting that consciousness must be nonreducible in the innocuous sense that what has consciousness is ultimately made of atoms and molecules. I would, therefore, not object to the classification of the various levels of complexity of consciousness in terms of computer programs which could be made to simulate mental activity at various levels. For example, levels that have been identified in increasing order of complexity are simple associative learning; conditioned-response learning; learning by having heuristic models in the program tried out as hypotheses to be tested against experience; self-monitoring, self-correcting feedback systems which learn from their mistakes in predicting the environment; and setups in which there is a kind of self-reflective property inside the computer which can model the state of the computer and its environment together. One can perhaps describe self-consciousness as being aware not only of our surroundings but also of ourselves within our surroundings. Would this then be a reductionist account of consciousness or not? It is certainly not reductive in the simple way that the Newtonian three-particle system is reductive, but it is possibly reductive in the sense that it does not require any more "hardware," as it were, than the atoms and molecules we have in our brains. It certainly does require much more complex, high-order relationships among these units, and these could possibly be describable in terms of computer programs. I do not myself see that anything is lost in one's understanding of consciousness by imagining it like that.