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THE EMF BIOEFFECTS DEBATE RESULTS FROM A PARADIGMATIC SHIFT

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OBJECTIVE

To evaluate the role of the received view of science in the EMF bioeffects debate.

OBSERVATIONS

Three characteristics of the debate are particularly salient. First, the validity of the debate itself is contested. The largest society of physicists in the United States has publicly questioned the existence or significance of EMF bioeffects, the study of which is the aim of several other scientific societies. Second, an unprecedented series of conflicts has occurred regarding the existence of *specific* bioeffects. Beginning with neurasthenia and calcium efflux, the pattern has continued unabated and now includes EMF effects on skeletal abnormalities, melatonin, transcription and translation, and cancer risk. Not a single EMF-induced bioeffect is accepted in the sense that special relativity, the theory of radioactive decay, or the law of gravity are accepted. Third, a strong correlation has emerged between the source of funding of EMF research and the implications of that research. Research sponsored by organizations that generate environmental EMFs as a byproduct of their activities consistently suggests that the EMFs are not a health risk, which is opposite to the inference of other pertinent research. These characteristics occur in varying shades in other disputes involving toxic agents.

ANALYSIS

The received view is that science explains observations in a value-free manner on the basis of natural *causes.* The standard for scientific explanation has traditionally been that of physics, in which causes (and causal mechanisms) are held to be necessary and sufficient factors whose mathematical form can be induced and whose prospective operation can be deduced. But in biology, as it is now practiced, a cause is simply a factor that is sufficient in the circumstances to produce an effect; causes are neither necessary nor sufficient, and are knowable independently of knowledge of mechanisms that mediate the effect. Biologists prove neither inductive generalizations nor particular cause-effect relationships, but rather *suggest* them based on arguments of plausibility and likelihood. Put another way, the method of physics is one of deduction from established law, the purpose being to explain the phenomenon not to establish its truth. The method of biology is one of abduction from a hypothesis, the purpose being to support the truth of the hypothesis, not to explain the phenomenon. If one adheres to the view that all legitimate scientific explanations are deductions, then the biologist's method cannot be accepted as valid, particularly when the study variable is a fundamental physical parameter like an EMF. Even the simplest living systems are insusceptible to precise prediction, not because physical laws don't apply but because we don't know how to apply them conveniently. Thus, the argument of the physicist that EMF bioeffects do not or cannot exist is not wrong but irrelevant because it is based on an inapplicable paradigm. The emergence of a new paradigm is also indicated by the conflicts regarding specific bioeffects. The success of the old approach with regard to nonliving systems is complete—all observations can be explained to any desired degree of precision on the basis of relatively few independent variables. But that success was no rational warrant that the same approach would be similarly successful in the study of living systems, which are affected by myriad causes that act simultaneously and nonlinearly. Empirical evidence—the grist of science and superior to any paradigm—has shown that the old approach cannot be so extended. The specific-bioeffects issue, therefore, is a direct result of the assumed model not the competence of particular investigators. Conflict is to be expected when investigators

approach specific phenomena from different directions. Finally, the old approach unrealistically excluded the role of values and self-interest in scientific judgments. An investor-owned power company surely does not want to cause cancer in a person who lives beside its powerline, but the company's interest in avoiding that result is different from that of the exposed person, and this difference will necessarily affect what experiments are done, who does them, what happens to the data, and how it is evaluated by blue-ribbon committees.

CONCLUSION

A paradigmatic shift is occurring in biology that involves (1) its methodology, and (2) the role of values in accepting what constitutes scientific knowledge. In the new paradigm, physics is biology's tool not its model, and values have some weight with regard to what constitutes scientific knowledge that impacts society.

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