intrinsic states of the system—but by allowing a certain absolute element in the special theory, the metric, to play a dynamical role: the metric satisfies equations of motion and represents the gravitational field. In the general theory of relativity, there are no absolute elements. This amounts to saying that every description is "natural." The class of free motions is now understood as the class of motions in a general gravitational field.

On the above interpretation of general relativity, which I understand as essentially Einstein's interpretation, general relativity is a principle theory of space-time structure. On the geometrodynamical interpretation, general relativity is a constructive theory of matter as the temporal behavior of space, considered as a substance whose internal structural constitution is characterized by the covariance group of general relativity.

From this standpoint, Graves completely misrepresents the sense in which Newtonian mechanics involves an absolute space-time. True, there are certain absolute elements, such as the time, the Euclidean metric, and a flat affine connection, which are invariant under transformations of the symmetry group. This is also the case for the space-time structure of special relativity, with respect to a different set of absolute objects. But in both theories, space-time structure is abstracted from the totality of mechanical events possible relative to the theory. This holds for the general theory of relativity as well. Elevating the status of the metric from an absolute to a dynamical object amounts to regarding the class of free motions as motions under gravity. It is completely absurd to suggest that this involves a constructive theory of matter as space. (One might equally well regard Newtonian mechanics with gravitation as a geometrodynamical theory, since the affine connection plays a partly dynamical role in this theory. See, for example, Trautman, *Soviet Physics* (*Uspekhi*) 9, 319, 1966.)

There are strong indications that the geometrodynamical program falls apart as a physical theory. Graves mentions an objection by Penrose that there are observable physical distinctions meaningful in general relativity that geometrodynamics cannot make. He remarks (p. 267): "Wheeler and Sharp have thus raised the interesting suggestion that the fault lies not in the ideal of physics as geometry, but in the choice of the particular *language* for expressing this ideal, that of local differential geometry based solely on the metric tensor. The moral of the Penrose problem is that we should search for other means of expressing geometrical concepts, rather than taking the historically first as an absolute."

The popularity of geometrodynamics as a theory of space-time owes much, I think, to an overreaction to conventionalism, which for the interpretation of general relativity involves a confusion of symmetry requirements with covariance conditions. As a philosophical position, it is a particularly simplistic theory of the evolution of space-time theories. *Jeffrey Bub, University of Western Ontario and Tel-Aviv University.*

ABSTRACTS FROM *INQUIRY*

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HIPPIES AND CYNICS

JASON XENAKIS

Hippiedom is the latest Cynic apparition. Both make fun of the rat race, money-making, accumulation, consumerism, uptightness, egodependence, puritanism, racism, nationalism, sexism. Their rebellions transcend particular times and places and share a common target. Even the expressions of rebellion are largely the same, from long hair to panhandling to sexualizing in public. Of course there are differences. Thus the Cynics were not social dropouts, although remember hippie offshoots like the yippies. Nor did they go for artificially-induced highs and self-confidence, though to them guts and freedom (as liberation, not primarily as option or responsibility) were the wildest things, man.

SCIENCE WITHOUT REDUCTION:

A CRITICISM OF REDUCTIONISM WITH SPECIAL REFERENCE TO HUMMELL AND OPP'S 'SOCIOLOGY WITHOUT SOCIOLOGY'

HELMUT F. SPINNER

The aim of this essay is a criticism of reductionism—both in its 'static' interpretation (usually referred to as the layer model or level-picture of science) and in its 'dynamic' interpretation (as a theory of the growth of scientific knowledge), with emphasis on the latter—from the point of view of Popperian fallibilism and Feyerabendian pluralism, but without being committed to the idiosyncrasies of these standpoints. In both aspects of criticism, the rejection is based on the proposal of a global alternative. Hummell and Opp's research program for the reduction of sociology to psychology is used as a starting-point and taken as the primary object of criticism. Following the introductory Section I, Section II analyzes the three crucial notions of Hummell and Opp's research program—the explications of the notions of "sociology," "psychology" and the concept of reduction itself—and criticizes the authors' deficient "logic of reduction." Although the "local" shortcomings of our authors' "logic of reduction" do not affect reductionism as such, i.e. logically sound versions of reductionism as devised by Kemeny, Nagel, Oppenheim, Putnam, Woodger, *et al.*, it is argued that the logical soundness of sophisticated reductionism cannot compensate for its additional epistemological and methodological deficiencies. Section III analyzes the "dynamic" interpretation of reductionism as a particular developmental pattern of scientific growth. It is argued that even reductionism at its best can produce only cumulative progress, thus *a priori* excluding scientific revolutions which are inevitably counterinductive as well as counterreductive. Section IV discusses the philosophical background of modern reductionism, and examines the effects both of reductionism and of antireductionistic pluralism on the autonomy of scientific fields. It is argued that pluralistic antireductionism undermines spurious claims for autonomy much more effectively than reductionism. As a "local" improvement of the reductionistic research program, the replacement of the predominant one-way reductionism by a less restrictive many-way reductionism is proposed. It is argued that the appropriate treatment for an allegedly backward science (say sociology) is not its reduction to an allegedly more advanced science (say psychology) but its nonreductive replacement by new theories (of the same or another field) that do not incorporate the older ones. As a "global" alternative to the reduction of sociology to psychology, the frontier-crossing direct application of psychological theories to sociological phenomena is proposed. A plea is made for a pluralistic science without reduction, based on intra- and interscientific criticism as the proper method for the advancement of knowledge.

THE SHALLOW AND THE DEEP, LONG-RANGE ECOLOGY MOVEMENT. A SUMMARY

ARNE NAESS

Ecologically responsible policies are concerned only in part with pollution and resource depletion. There are deeper concerns which touch upon principles of diversity, complexity, autonomy, decentralization, symbiosis, egalitarianism, and classlessness.

REVIEW DISCUSSIONS:

I. CAUSES OR REASONS?

R. Borger and F. Cioffi (Eds.), *Explanation in the Behavioural Sciences: Confrontations*, JOHN WATLING

II. PHILOSOPHY AND SOCIAL ROLE

Maurice Natanson, *The Journeying Self: A Study in Philosophy and Social Role*, ALASTAIR HANNAY.

III. CONCEPTS AND SOCIETY

I. C. Jarvie, *Concepts and Society*, A. R. LOUCH.