many of the workshop sessions "most productive." If they helped to enlighten her on the great problems of peace and disarmament, they served a useful purpose. It should be noted, however, that many people who are professionally involved with these problems were considerably less enthusiastic about the workshop results.

I think Stonier is too charitable to the congress's organizers when he writes that the confusion was attributable, in part, to the complexities of the problems under study. Chaos is not a necessary concomitant of attempts to deal with difficult problems. The congress did not break down because it could not find a quick solution to the world's sorry state; it broke down because it suffered from an overabundance of good intentions and a dearth of hard thought. Its guiding lights failed to recognize that if S.O.S. is ever to achieve any influence with policy makers, its recommendations must be based on more than a desire to do good. Anyone has a right to be against civil defense, but when an organization that purports to be "scientific" says it is against civil defense, it is not unreasonable to expect that it has looked into the matter, a step which S.O.S. neglected in its enthusiasm to get to work on the grave problems that afflict mankind.

—D. S. GREENBERG

Hybrid Enzymes and Isozymes

The publication of two articles on hybrid enzymes in the same week, one by Cahn, Kaplan, Levine, and Zwilling (*1*) and the other by Drew Schwarz (*2*), emphasizes the complexity of the problem of multiple molecular forms of enzymes as well as the differences in viewpoint. The thesis of Cahn and his associates is that the five electrophoretically distinct types of lactic dehydrogenase (LDH) arise as a result of combinations of two different subunits (M and H) to form tetramers, three of these types being "hybrid" enzymes. On the basis of "indirect" genetic methods—that is, comparison of species differences in lactic dehydrogenases, these authors conclude that M and H are under the control of "different" genes, presumably at different loci. The associations of M and H that give rise to the hybrids are presumed to occur at random.

The hybrid enzymes of Schwarz

occur in maize heterozygous for alleles at the *E* (esterase) locus (*2*). A heterozygote produces three electrophoretically distinct types of esterases: two parental types and a hybrid type that lies midway between the parental types. A comparison of cells with different gene dosages suggested that each type occurs as a dimer. These esterases are bound to particles obtained by centrifugation for 2 hours at 105,000*g* in cells that are actively synthesizing enzyme. Experiments with mixtures of cell fractions from different genotypes showed that the hybrid enzyme appears only in the heterozygote and that it is bound to the particles. It does not arise as a result of adsorption of "formed" enzyme. Schwarz concludes that the hybrid esterase arises *during* protein synthesis under the joint influence of ribonucleic messengers from the two alleles.

These studies point up the difficulties of trying to "classify" macromolecules. On the one hand, a hybrid enzyme is produced under the influence of genes at different loci (*1*); in the other case, a hybrid enzyme results from interaction of alleles at a single locus (*2*). As the evidence accumulates, it may be possible one day to devise a "taxonomy" for macromolecules. Until then, it should be pointed out that a particular type of macromolecule, such as a hybrid enzyme, may arise through various routes of synthesis.

Cahn *et al.* (*1*) make the distinction between a hybrid enzyme and an isozyme. They suggest that an isozyme is more restricted in its composition. In the strictest sense, isozymes are the products of a single gene (*3, 4*). Recently my co-workers and I have found evidence for the formation of both isozymes and hybrid acid phosphatases under the control of alleles at a single locus in variety 1 of *Tetrahymena pyriformis* (*5*). One of the homozygotes produces three isozymes; the other homozygote produces only one. The heterozygote ($P\text{-}1^A/P\text{-}1^B$) forms hybrid phosphatases intermediate in electrophoretic position to the parental phosphatases. Five electrophoretically distinct types are produced, in various proportions, in different cell lineages of the heterozygote. In this case, the five types of acid phosphatases are the joint products of alleles at a single locus.

Cahn *et al.* (*1*) suggest that the M and H lactic dehydrogenases may op-

erate under different metabolic conditions. These functional differences appear to have developmental and evolutionary consequences. Differences in localization of the lactic dehydrogenases within a single cell (*6*) might also be stressed. Thus, the tertiary structure of a macromolecule may be modified by its incorporation into the three-dimensional framework of the cell. Such localization to specific cell sites could restrict the randomness of the system. In *Tetrahymena* the esterases and acid phosphatases are "particulate" bound (*3*, *5*). In the case of the esterase isozymes a differential localization of members of the isozymic set occurs. Mutation may even affect an isozyme by shifting its position in the cell (*7*).

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The Individual in History and in Cultural Evolution

The recent article by Thomas Kuhn, "Historical structure of scientific discovery" [*Science* **136**, 760 (1962)], has some significance for cultural evolution as well as for history, particularly in its discussion of the importance of the individual in discovery. There is an established tendency in historiography to segment the past arbitrarily into units that coincide with the lives and accomplishments of great men. Besides being a useful means of ordering the narrative, this tendency reflects the well-inculcated feeling that the individual is of prime importance in "shaping" the course of events.

For defining and describing specific things and events of the past—in their structural aspects—the historian finds this diachronic segmentation not only convenient but advisable. The past must