for two generations, and its safe and toxic levels have been documented [N. E. Artz and E. M. Osman, *Biochemistry of Glucuronic Acid* (Academic Press, New York, 1950)]. There are numerous references dealing with its administration to experimental animals and to man.

Our critics do not document the basis of their expressed fear that by lowering the level of bilirubin in the blood we are driving it into the tissues. It was presumably based on two observations that have been recently reported—the finding of Silverman *et al.* [*Pediatrics* **18**, 614 (1956)] that certain sulfa drugs, notably sulfasoxazole, would facilitate the passage of bilirubin from the blood stream into the brain and the finding by Johnson, Sarmiento, and Day [*Trans. Soc. Pediatric Research* (1958), p. 63] that kernicterus occurred in five rats of the Gunn strain whose bilirubin was lowered by the administration of glucuronic acid.

We should like to point to evidence that glucuronic acid and sulfa drugs do not act similarly on bilirubin. Odell [*Trans. Soc. Pediatric Research* (1958), p. 147] has made in vitro studies of sera with a high bilirubin content. When sulfa drugs were added to such sera and the sera were ultrafiltered, the bilirubin passed out into the ultrafiltrate, presumably because the sulfonamide displaced bilirubin from combination with serum proteins. The addition of glucuronic acid to serum had no such effect. Regarding the Gunn rats, we do not question the observation that increased bilirubin concentrations of the tissues may have occurred. These rats, however, differ from newborn infants in several respects. Their skin was noted to become increasingly icteric after administration of glucuronic acid, whereas in our infants not only was a decrease in skin icterus observed but this was confirmed by measurements of the bilirubin specimens of subcutaneous fat obtained at biopsy before and after therapy. For these reasons and because of our favorable clinical experiences we do not share the fears that have been expressed.

STUART DANOFF, CHARLOTTE GRANTZ, AUDREY BOYER, L. EMMET HOLT, JR.
New York University College of Medicine, New York

Human Values

H. J. Muller's recent article [*Science*, **127**, 625 (1958)] on the evolutionary basis of human values was most interesting and informative. As one not trained in biological science, I certainly accept his interpretation of the evidence as authoritative. However, since he follows his scientific discussion by proposing a system of ethics, I think that I am no further afield in commenting on his ideas than he is in presenting them.

As a result of natural selection, Muller points out, species for which social living is helpful for survival develop natural tendencies and desires which promote the success of cooperative enterprises. Thus, such ideas as "brotherly love" have a basis in natural evolution. In human beings, then, these inherited tendencies mean that actions which advance the welfare of one's fellows—thus aiding the survival of the species—satisfy basic natural desires and are therefore emotionally rewarding. In addition, the culture based upon this natural heritage recognizes the need for cooperative actions and adds its own rewards and punishments. On the other hand, as a society grows large, individuals who do not have these genetic traits are no longer discriminated against but are helped by the society to adopt the necessary cooperative attitudes. This leads to a gradual dilution of the genetic basis of the cooperative society.

From these considerations, Muller proposes that a new system of ethics be adopted, based upon the idea that those actions which contribute to the survival and advancement of the species be regarded as good and praiseworthy and that opposing actions be condemned. Clearly, from the biological discussion it is necessary that any successful system of

ethics include these features—ethics must be in harmony with nature—but it does not follow that they are a sufficient foundation for such a structure. Included in the basis of ethics must be a system of rewards for the individual who conforms. Inspiring phrases about the advancement of the species will probably have little appeal to the less educated, and perhaps even some educated nonbiologists may have misgivings as to whether the species is worth the trouble. Of course, those whose heredity gives them cooperative tendencies will find inner harmony from ethical and humane behavior, but such people are presumably becoming fewer. In the future we must place increasing reliance on culturally imposed motivation, and it seems unlikely that such forces could successfully oppose strong antisocial attitudes, perhaps arising from mutations, if these became widespread. Indeed, since we have been living for many generations in a fairly large and complex society, we ought already to see signs of the dilution of its genetic base. Nevertheless, recent times have shown a tremendous increase in the number of people and agencies engaged, and in the amount of effort and money spent, in aiding unfortunate persons. In short, recent history shows trends apparently in conflict with the idea of inherited traits as the only basis for society, and the ethics based solely on the advancement of the species seem to hold little hope for the future.

In view of these shortcomings, I, for one, am not inclined to join Muller's crusade to change man's concept of values in accordance with a "scientific ethics." Since science is basically concerned with what is "true" about nature and is therefore amoral, it seems unlikely that it can do more than lay down some necessary conditions for an ethical system.

WALTER K. BONSACK
California Institute of Technology, Pasadena

Walter K. Bonsack's letter appears to say that if the evolutionary interpretation presented in my article were correct, genetic degeneration would today be, and would for some time past have been, overriding cultural improvement in regard to matters of morals and ethics, whereas it is obvious that, on the contrary, society is becoming increasingly socially oriented, in some areas at least. My article did not maintain that an actual retrogression of the genetic basis of moral conduct is occurring, although it did present grounds for the inference that there has been a falling off of its rate of advance. This may or may not be enough to constitute a retrogression. On this point far more factual evidence is needed. However, in any case, the rate of the genetic change must be several orders of magnitude lower than the present rate of cultural improvement.

The vastly greater speed of the cultural changes does not, however, cause the genetic process to be less important in the long run. In regard to this genetic process, it should be recognized that the fatalistic attitude of all past ages, that man can do nothing about his own hereditary constitution, is as unjustified and outmoded as a completely *laisser faire* economics.

Bonsack's final remark that science, being concerned with what is true, "is therefore amoral" exemplifies the widespread view that (as I put the case in my article) matters of value "cannot profitably be argued about." It was a major purpose of my article to bring forward evidence against this very view. However, as I pointed out in my introductory remarks, some persons are "irrevocably committed" to this position, and my discussion was not addressed to them. For there can, *ipso facto*, be no reasoning with them about these matters.

H. J. MULLER
Indiana University, Bloomington