stock under conditions of weak illumination the possession of red or white eyes might make the difference between a fly's crawling toward the light or not crawling at all, an enormous difference in behavior, whereas under other conditions the same factor might produce little effect. It also seems likely that the large behavior difference observed in mice was associated with a threshold of training.

The sort of situation in which heredity may shift the threshold of stimulation or performance is theoretically possible in any animal. Human life (at least in the United States) appears to have many threshold situations, from athletic contests to social barriers. Acting as a "last straw" in certain special environments it is possible that heredity may produce in the behavior of human individuals differences whose importance is all out of proportion to its general effect.

Certain words of caution regarding this suggestion need to be spoken. Differences produced by environmental factors may also be magnified by a threshold. Because of the presumably greater powers of learning of human beings it must be expected that heredity will be found to have smaller effects upon behavior than in the lower animals. Furthermore, this idea applies only to individuals under special conditions and does not apply to large groups with variable heredity and environments.

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## PHOTOGRAPHY OF CRYSTAL STRUCTURES

SIR LAWRENCE BRAGG[1] has shown that Fourier series summations of x-ray diffraction data from a crystal can be made optically, yielding "photographs" of the crystal structure, in which the individual atoms are seen in their proper relative positions. The method is essentially a superposition of exposures of patterns of light and dark bands, the choice of band patterns and the lengths of exposure being determined by the x-ray data.

As shown previously by the writer,[2] this method can be made much easier and faster by the use of a previously prepared set of masks, on which the proper patterns are printed. The same set serves for all structures and for both electron density summations and Patterson summations. A set of 316 such masks, on a roll of 35 mm film, has recently been prepared in these laboratories. With it, pictures of structures for which suitable x-ray data are available can easily be made in a half hour. Magnifications of 100,000,000 or more are readily obtained.

Although the accuracy of atomic positions and of relative electron density values at different points in the structure is undoubtedly less than can be obtained by computational methods, the ease and speed of the photographic method should make it useful both in working out new structures and as an aid in the description of structures which have already been deduced.

We hope soon to be able to furnish duplicate copies of our new set of masks, at a nominal cost, to others engaged in crystal structure analysis.

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[1] W. L. Bragg, *Z. Krist.*, A70: 475, 1929; "The Crystalline State," p. 229, London and New York: Macmillan. 1934.

[2] M. L. Huggins, *Jour. Am. Chem. Soc.*, 63: 66, 1941.

## HUMAN GENETICS AND ANTHROPOLOGY

ANTHROPOLOGISTS and human geneticists have many problems in common, and it would seem that they would see eye to eye on major issues. They probably do on most, but apparently not on all. At least in recent comments in SCIENCE Professors Herskovits[1] and Ashley Montagu[3] have questioned the actuality or even the reasonableness of the existence of physiological and inherent response differences between major subdivisions of the human species.

In my comment[2] on Professor Herskovits's note I wrote: "If primary human stocks (Mongoloid, Negroid and Caucasoid) and if subdivisions of these major groups ('races') have any validity at all, and the author believes that Professor Herskovits will admit that they do have some, it seems almost inevitable that both physiological and inherent response differences must exist." In a later issue of SCIENCE Professor Ashley Montagu[3] commented as follows: "At first blush this seems a reasonable enough statement but when one inquires why it appears to be so it will be found that it is suspected that physical characters are probably linked with functional ones, that there is a genetic linkage between the genes for the two different orders of phenomena." He continues: "If such is the ground upon which this assumption is usually made then it ceases to be a reasonable one, for the good reason that it is based on no more than a suspicion or a hunch and not upon facts which are known to exist or have been demonstrated." He adds later, "Genetic linkage between particular physical traits and particular psychological traits is a phenomenon unknown outside folk belief."

May I add at once that the reason presented by Professor Ashley Montagu is not the one which makes it seem almost inevitable that inherited physiological and psychological differences exist between primary human stocks and races. In fact, the reason he presents has no bearing on the question at issue. The

[1] SCIENCE, n.s., 100: 457–461.
[2] SCIENCE, n.s., 100: 146–147.
[3] SCIENCE, n.s., 100: 383–384.

reasoning on a basis of which my original statement was made is this: Physical differences which characterize primary human stocks and races are in a large measure a consequence of chance samplings of hereditary materials which took place at the time ancestral groups separated, plus accumulations of different new variations in hereditary materials which have occurred since the groups became isolated. Many physiological and response differences within the human species have been shown to have some genetic basis (see below), therefore one should also expect that chance samplings and accumulations of different new hereditary materials would have taken place with respect to them.

Professor Ashley Montagu may question the existence of physiological and response differences between human individuals which have some genetic basis, but the evidence for such differences is accumulating rapidly. As a matter of fact what are inherited physical differences between individuals and races but expressions of physiological differences? Surely in this day and age no one believes that black hair or blond hair are inherited as such from mother or father. What is inherited is a set of chemical materials (genes) representative of black or blond hair, which through physiological processes are responsible for the production of a particular type or amount of pigment. Inherited physiological differences in this sense, therefore, exist without question. Inherited physiological or response differences which can not or have not been expressed in terms of readily seen physical manifestations are not as readily cited, but even many of this type could be listed. For example, one could mention: (1) inherited differences in metabolic processes with respect to the formation of alcapton, porphyrin, albumin, etc.; (2) inherited differences in blood characteristics (A–B, M–N, hemophilia, sickle cell anemia, Rh, etc.); (3) inherited differences in taste (P.T.C.); (4) inherited differences in vision (color blindness, night-blindness, myopia, etc.); (5) inherited differences in response patterns (ataxias, choreas, oligophrenias, etc.). Many more could be listed. I have chosen only some of the better known ones.

Now it is only fair to state that only a few physiological or response characteristics, even of those listed above, have been studied from a racial point of view, but of those which have been investigated a fair number has been shown to be represented by racial differences. It is true that most of the differences observed are only differences in frequency of occurrence of the characteristic in question and therefore represent only a difference in gene frequencies, but even such differences are important to our understanding of the genetics of human populations.

What apparently plagues certain individuals is a fear that a study of racial differences will engender racist doctrines of superiority and inferiority. I appreciate this possibility and am in sympathy with that fear. However, I am equally fearful of opinions and tendencies which operate to close the door of investigation. I am convinced that as scientists we can best help check the growth of unwarranted dogmas by knowing what the facts are.

May I comment briefly on the argument presented by Professor Ashley Montagu relative to genetic linkage between traits. It apparently is a common notion among laymen and even scientists not familiar with genetic principles that characters which are linked should be found together in a population. That is true for a few generations only. In a population which has been breeding at random for a fairly large number of generations even linked characters should be distributed at random within that population.

I should not continue these discussions in SCIENCE on these matters of human inheritance were I not deeply concerned about the issues involved. Human genetics is developing rapidly at the present time, and I am of the opinion that much that it is discovering is for the good of humanity. For that reason alone it would be unfortunate if erroneous opinions prevailed and served as a check on present and future scientific studies within its realm. Anyway, physical anthropologists and human geneticists should agree on major issues and should work in harmony, because their fields of inquiry are closely allied. I believe that we can agree and work harmoniously if we are willing to air freely such differences in opinion as may exist.

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## DATA ON CANCER THERAPY

AT the Gibson Island Cancer Symposium in August, 1944, a suggestion was made that some one compile and publish all the data available relative to cancer therapy. Such a survey might be expected to aid other workers in planning systematic studies in this field of cancer research. The National Cancer Institute has offered to undertake this work.

All types of therapy except surgery and irradiation will be covered. Negative and positive results of the treatment of spontaneous, transplanted and induced experimental tumors, and of clinical cases, will be included. It has been found that negative results which have been obtained have not always been published. The data will be classified and tabulated in a simple manner similar to that in Hartwell's "Survey of Compounds Which Have Been Tested for Carcinogenic Activity," National Cancer Institute, 1941, and will include the name of the agent, the number of ani-